

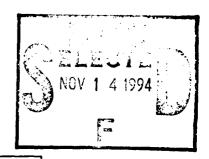
# NAVAL POSTGRADUATE SCHOOL Monterey, California





THESIS





AN INVESTIGATION INTO THE LONG-TERM IMPACT OF THE CALIBRATION OF SOFTWARE ESTIMATION MODELS USING RAW HISTORICAL DATA

by

Daryl Allen Shadle

September, 1994

Thesis Advisor

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by

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Submitted in partial fulfillment of the requirements for the degree of

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# **ABSTRACT**

The benefit of software cost estimation is universally recognized as one of the cornerstones of effective software project management and control. Despite the advances of computer-based estimation tools, their accuracy remains largely inadequate, and their utility among software development practitioners is limited. Consequently, the optimal estimation of software cost remains an elusive goal of most project managers. Central to this issue is the nature of the data on completed software projects that are incorporated into the organization's database of historical project results. This information forms the basis for both future project estimation and ex-post-facto assessment of estimation models. Actual project results are typically the data of choice for both the calibration and evaluation processes, despite the fact that these raw values disregard project inefficiencies such as initial size underestimation. This thesis challenges the notion that historical project results represent the preferred and most reliable benchmarks for future estimation purposes. Computer-based simulation is used to test a proposed strategy which capitalizes on an organization's learning experiences by neutralizing the cost excess caused by the initial undersizing, and that derives a posterior set of normalized effort and schedule estimation benchmarks. Analysis of the results indicates that normalization of the data leads to significantly improved project productivity, more optimal cost estimates, and provides the organization with increased potential for future cost savings

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## I. INTRODUCTION

#### A. BACKGROUND

The benefit of reliable software cost estimation is recognized as one of the cornerstones of effective software project management and control (Boehm, 1981, p.30). Nevertheless, accurate estimation of software development costs remains an elusive goal of most project managers, despite the proliferation of software engineering economic analysis techniques and the availability of computer-based software project management tools (Abdel-Hamid, 1990, p.71).

Software development has traditionally been viewed as a discrete set of software development life cycle (SDLC) phases, when in fact, research findings point to a dynamic environment characterized by continuous changes over time (Goddard Space Flight Center, 1990). Consequently, problems inherent with the estimation process itself, normally positioned at the beginning of the SDLC, have generally limited the utility of estimation tools based on this traditional view of software development.

Without the benefit of full knowledge of a project's ultimate scope and definition at the time of initial cost estimation, an estimation model must possess the capability to respond to influencing factors which unfold as the project progresses through the SDLC. Abdel-Hamid states that "...estimation should be a *continuous* process enhanced through constant updates of feedback data collected from project monitoring and control activities...." He argues that continuous estimation models must support the full range of

estimation activities regularly encountered in the SDLC; adaptive (accommodate new organizational realities), corrective (correct initial faulty assumptions) and perfective (postmortems to perfect project statistics). In so doing, it is imperative that the model also possess the capability to capture management-system dynamics -- project managers' reactions to real-world events as they unfold. (Abdel-Hamid, 1993. pp. 20-21)

Despite the improvements realized with the introduction of genuine continuous estimation models, their accuracy remains largely inadequate. Central to this issue is the nature of the data on completed software projects that are incorporated into the organization's database of historical project results. This archived information subsequently forms the basis for both future project estimation and ex-post-facto evaluation of software cost estimation models. Quite simply, this data is used to produce the organization's "best guess" of what a project of similar size and scope *should* require, in terms of development effort and schedule, if encountered in the future. In addition, it is these data values upon which estimation tool calibration, or fine-tuning to produce more accurate estimates which reflect the organization's unique software development environment, is based.

Raw project values, which represent actual results, are the conventional "data of choice" for both the estimation and calibration processes. While raw data, indeed, reflect actual results, they may certainly not reflect *optimum* results, particularly in the case of a problematic project. Inefficiencies such as initial size underestimation, plague many, if not all software development projects, and are manifested in varying degrees of cost

overruns and schedule slippages. As such, direct incorporation of raw values into the historical database tends to discount the impact of these inefficiencies on project results. Instead, it merely archives this flawed information for future (mis)application, and perpetuates the cycle of inefficiency and imprecise estimation.

In response, Abdel-Hamid has proposed a strategy which "...capitalizes on an organization's learning experiences, by wringing out the cost excess caused by the initial undersizing and that derives a posterior set of normalized cost and schedule estimation benchmarks." (Abdel-Hamid, 1993, p. 28) These normalized values are representative of a perfectly-sized software project, and consequently should provide the organization with a more efficient benchmark for future project estimation and planning, and in retrospect, evaluating how well project resources were used.

#### **B. PURPOSE OF RESEARCH**

This research challenges the notion that raw historical values represent the preferred benchmark for calibrating software cost estimation models. Computer-based simulation is used to model the behavior of a number of synthetic project profiles to test the assumptions of both the conventional and normalized strategies for software estimation model calibration. Various experimental conditions are imposed on subsequent experiments to compare project results and identify causal relationships in an effort to substantiate the research claims.

## C. THE RESEARCH QUESTION

The primary research question of this thesis is to determine if there is long-term benefit in using normalized software project cost values vice raw historical data as the benchmark for calibrating software estimation models.

#### D. SCOPE OF RESEARCH

The scope of this research includes the design, execution and analysis of a computer-simulated, multiple-project experiment, and comparing the results of two competing soft-ware estimation calibration strategies, in order to answer the research question. Its scope does not extend beyond the research laboratory, and there are no immediate plans for replicating this experiment in a real-world environment.

#### E. THESIS ORGANIZATION

Chapter II offers a statement of the experiment's objectives and a comprehensive description of the experimentation tools, to include the COnstructive COst MOdel of Software Cost Estimation (COCOMO) and the System Dynamics (SD) Model of Software Project Development. In addition, Chapter II presents the experimental design, where the hypothetical projects, project profiles and influencing factors and assumptions are defined in detail. A key element of Chapter II is a discussion of the competing software estimation model calibration strategies which form the basis of this research. Chapter III describes the experimental setting and related tasks, and elaborates on exercise organization, methodology and conduct. In addition, the dependent measures which represent key exercise metrics, are defined as they relate to analyzing and comparing exercise results.

Chapter IV presents the results of the various experiments and offers insight and analysis of the research findings. Chapter V summarizes the findings of the previous chapters, discusses the implications of this study, and proposes related opportunities and directions for future research.

### II. METHOD AND PREPARATION

#### A. EXPERIMENTAL OBJECTIVE

This experiment will use a system dynamics model of software development to simulate the development of a set of 30 projects in a software organization, conducted by over an approximate 12-year period. The simulated results will be incorporated into an organizational data base and used as the basis for both subsequent project estimation and calibration of the estimation tool. Two scenarios will be evaluated: the conventional method of calibration using raw historical data and an alternative calibration method using "normalized" metrics.

#### **B. EXPERIMENTATION TOOLS**

# 1. Constructive Cost Model (COCOMO)

The COnstructive COst MOdel, or COCOMO, was developed by Barry Boehm, and is a widely-accepted algorithmic model which is used to determine initial software development effort and schedule estimates. As a result of model refinement since its introduction, three model versions and three software development modes have evolved. The three versions include Basic, Intermediate and Detailed COCOMO, each of increasing detail and accuracy. Organic, Semidetached, and Embedded software development modes have been defined to accommodate the broad spectrum of project size, specificity, and risk encountered in the software development environment.

Basic COCOMO is the simplest version of the model, and is effective for rough order of magnitude estimates of software cost. However, Boehm cautions, "... its accuracy is necessarily limited because of its lack of factors to account for differences in hardware constraints, personnel quality and experience, use of modern tools and techniques, and other project attributes known to have a significant influence on software costs...."

(Boehm, 1981, p. 58) With Basic COCOMO, estimates of effort are generated using only a single predictor variable, namely the number of delivered source instructions (DSI) developed by the project.

Intermediate COCOMO improves upon the Basic version by incorporating an additional 15 predictor variables, or cost driver attributes, which are carefully identified, weighted and introduced in order to offset much of the cost variation found in Basic COCOMO. The 15 cost drivers are subdivided into four categories: software product attributes, computer attributes, personnel attributes, and project attributes. Each cost driver has an associated effort multiplier which is applied to the nominal development effort to obtain a more accurate estimate. Boehm contends that the level of accuracy achieved with Intermediate COCOMO "... is representative of the current state of the art in software cost models." (Boehm, 1984, p. 16)

Detailed COCOMO provides the highest level of estimation accuracy by providing even more detail as model input. This is accomplished by employing a three-level hierarchical decomposition of the software product whose cost is to be estimated. In

addition, phase-sensitive effort multipliers are used to accurately reflect the effect of the cost drivers on the phase distribution of effort. (Boehm, 1981, pp. 347-348)

The three COCOMO modes of software development were defined as a result of research findings suggesting that software products of the same size often require varying degrees of effort and development time. Consequently, each of the COCOMO software development mode's effort and schedule equations will yield significantly different cost estimates. Hence, precise identification of the applicable mode, by means of its distinguishing features, is critical in order to prevent estimation inaccuracies.

The organic mode represents projects that are relatively small in size, developed by small software teams in a generally stable development environment. Experience levels are high, while schedule and performance pressures are generally lower.

The semidetached mode represents the middle ground between the organic and embedded modes. Flexibility of approach is a trademark of the semidetached mode, as intermediate levels of project characteristics and a blend of organic and embedded mode characteristics may be encountered in the same project.

Finally, the embedded mode represents a project that must operate within tight constraints. Requirements and interface specifications are generally inflexible, and can dictate a considerable need for innovative architectures, algorithms or functionalities.

(Boehm, 1981, p.81)

In this series of experiments, the Basic COCOMO version will be utilized as the software estimation model. While Intermediate COCOMO estimates have proven clearly

superior, the rudimentary nature of the Basic COCOMO (only size input - no cost driver attributes) facilitates evaluation of model characteristics in conjunction with the SD simulator. Likewise, the organic software development mode complements the choice of Basic COCOMO, and assumes a stable baseline software development environment in which the experiments can be conducted.

# 2. A Dynamic Simulation Model of Software Development

Research has underscored the impracticalities of controlled experimentation in the software engineering field as being excessively costly and time-consuming (Myers, 1978). Simulation modeling provides a flexible and ideal environment in which competing assumptions and conditions may be tested. Unlike real systems, the effects of variable manipulation on internal system interactions can be isolated and more carefully studied. Consequently, for purposes of this experiment, simulation modeling was chosen as the experimental method by which the research question would be answered.

The System Dynamics (SD) Model of Software Project Development, by Abdel-Hamid and Madnick, is a comprehensive, highly-detailed, quantitative simulation model which captures management-system dynamics and provides a continuous simulation capability. Based on the feedback principles of system dynamics, the model focuses on four interconnected subsystems, which integrate managerial decision-making activities (e.g., scheduling, productivity, and staffing) with the physical production of the software product (e.g., design, coding, reviewing, and testing). The four subsystems are

human resource management, software production, controlling, and planning.

(Abdel-Hamid, 1993, p. 24)

The purpose of the SD simulator is to serve as a laboratory vehicle for conducting experimentation into the dynamics of software development. As such, it provides a much-needed means by which the managerial side of the software development process might be more carefully examined and, hopefully, better understood. By design, the model does not deliver point predictions, but rather seeks to provide a general understanding of the nature of the dynamic behavior of a project. An important functionality of the model is the ability to perform sensitivity analysis, or "what-if" experiments, in order to develop a more complete understanding of the interrelationships of software development variables and identification of causal relationships.

The model has been designed for use on medium sized, organic type software projects (i.e., projects that are 10,000 to 250,000 lines of code and conducted in familiar, in-house development environments) (Stephan, 1992, p. 13). For a detailed discussion of the model's actual structure, formulation and validation, see Abdel-Hamid and Madnick (1989 and 1991).

#### C. EXPERIMENTAL DESIGN

## 1. Definition of Experimental Projects

Five hypothetical software development projects, of varying representative sizes, were initially defined and serialized as projects one through five. Their size was established in terms of thousands of delivered source instructions (KDSI) to match both

the COCOMO and SD simulator input parameters. Table 1 presents project serials and their respective sizes, which remain fixed throughout all experiments.

Project Serial	Actual Size (KDSI)
1	40
2	50
3	60
4	70
5	80

Table 1. Experimental Projects and Sizes

## 2. Underestimation of Project Size

Boehm states, "The software undersizing problem is our most critical road block to accurate software cost estimation." He cites three main reasons for this perplexing phenomenon. First, people's optimistic and accommodating nature drive them to say what others want to hear. High estimates are fuel for confrontation, whereas everyone is happy with small, easy software. The second reason involves incomplete recall of the large amount of support software that must be developed as part of a project — there is generally a stronger recollection of the size and effort required for the much smaller, but more visible, operational software. The third reason is related to the incomplete recall issue. Unfamiliarity with the full scope of the software project causes people to overlook the more obscure software products (and obscure portions of each product) which need to be developed. There are no quick fixes to the pervasive undersizing problem other than to understand the sources of the problem, and apply that understanding to software sizing activities. (Boehm, 1981, pp. 320-323)

A study of the impact of undersizing on software estimation forms the focus of much of this experiment. Consequently, underestimation levels, expressed as a percentage of actual project size, are applied to the individual project serials in accordance with the experimental project profile, which is defined in a subsequent section of this report. Underestimation levels are defined and presented in Table 2.

Level	Underestimation (%)
1	10
2	20
3	30
4	40
5	50

Table 2. Project Size Underestimation Levels

Undersizing has a direct effect on both the software cost model (COCOMO) and the simulation model (SD simulator) results. Quite simply, a too-small sizing estimate invariably results in a too-small cost estimate. For example, a 50 KDSI project, undersized by 20 percent, results in a Basic COCOMO estimation identical to that of an accurately-sized 40 KDSI project.

## 3. Development of Project Profiles

The experiment seeks to model and analyze the software development activities of a hypothetical organization over time. In developing a project profile for the organization, particular attention was paid to a number of conditions within the organization that would accomplish exercise objectives, while maintaining a reasonable degree of realism with respect to the functioning of an actual software development organization.

## a. Project Teams

Five hypothetical software development teams are constructively assembled. As teams, they will be assigned to one of the project serials — one team for each project serial. There was no consideration given to team make-up in assembling the teams. Although disregard for the effects of personnel attributes on team performance represents an exercise artificiality, the assumption of essentially "homogeneous" project teams facilitates unbiased interpretation of the exercise results.

## b. Project Cycles

In order to investigate the long-term impact of calibration strategies on software cost estimation, follow-on projects to the five project serials already defined is required. Consequently, the concept of a project cycle is introduced. A project cycle is defined as that period of time required for each of the five individual project serials to be completed. The first iteration of this scheme is referred to as "Project Cycle One", whereas subsequent iterations are labeled "Project Cycle Two", "Project Cycle Three", etc. For purposes of this experiment, organizational software development activities will span six project cycles.

# c. Initial Project Team Assignments

With teams assembled, and projects and project cycles defined, the next step is to determine a strategy for project assignment. Here the assumption is that all five software development teams will commence work on the five project serials concurrently, at time zero. For simplicity, and to provide a convenient project profile starting point,

assignment of projects in project cycle one matches team one with project one, team two with project two, etc.. Table 3 outlines cycle one project assignments.

Project Cycle One									
Project Team Project Assignment									
One	1								
Two	2								
Three	3								
Four	4								
Five	5								

Table 3. Cycle One: Team and Project Assignments

# d. Allocation of Undersizing Factors

In order to examine the effects of undersizing on projects of varying size, the previously-defined size underestimation levels (Table 2) must be allocated in a random manner across all projects. For project cycle one, this was accomplished by using a table of numbers generated by a random process. Table 4 is such a table and is used in the experiment. By arbitrarily selecting the intersection of any row and column as the starting point, a list of five numbers is systematically drawn by moving either to the left or right, or upward or downward from this starting point until one of the underestimation level values is encountered. This number is recorded in the list, and the movement continues until a second number within the allowable range (one through five) is encountered. After this second value is recorded in the list, the process repeats three more times until the randomized list of five numbers is complete. For example, underestimation levels are allocated for project cycle one by choosing row 5, column 13

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•																					

Table 4. Table of Random Numbers. After Ref. (Roscoe, 1975, p. 410)

(Table 4) as the starting point and moving across the row to the right. The following randomized list is generated: 4 - 2 - 3 - 5 - 1. These numerical values, corresponding to underestimation levels, are allocated to cycle one projects as shown in Table 5.

Project Cycle One								
Project #	Undersizing Level							
1	4							
2	2							
3	3							
4	5							
5	1							

Table 5. Cycle One: Projects and Undersizing Levels

For project cycles two through six, undersizing levels are allocated in accordance with the Latin Square Design (Daniel and Terrell, 1975, pp. 209-215). Once the cycle-one undersizing levels are determined and allocated to the five project serials in ascending project-size order, Latin Square imposes a one-position downward shift of row values to produce the undersizing allocation for cycle two. The procedure is repeated through the six project cycles, which results in cycle-six undersizing levels identical to those in cycle one. Table 6 presents the undersizing allocation for all projects across all project cycles. This allocation plan is fixed, and is used for all experiments where software size underestimation is assumed.

				Project	Cycle	,	
Project #	KDSI	1	2	3	4	5	6
				Jnderestim	ation Leve	:I	·····
1	40	4	1	5	3	2	4
2	50	2	4	1	5	3	2
3	60	3	2	4	1	5	3
4	70	5	3	2	4	1	5
5	80	1	5	3	2	4	1

Table 6. Project Undersizing Allocation

# e. Project Team Assignments in Cycles Two through Six

In developing the project profile, it was decided that when a project team completed their assigned project in cycle one, they would immediately be assigned a new project and commence work in cycle two. That is, the team that finishes their cycle-one project first, is assigned the first available project in cycle two. The second team to finish cycle one gets the next available project in cycle two, and so on, until all five teams "arrive" in project cycle two. Subsequent project assignments are determined in the same manner through project cycle five.

The sequence of next-available projects for project cycles two through five are randomly assigned. Their project assignment orders are determined by employing the same randomization techniques described in the previous section, but with different starting coordinates and directions of movement for generating the randomized list for each cycle.

To facilitate comparative analysis of results with cycle one projects, cycle six team assignments replicate their initial project assignments. Table 7 defines the next-available project scheme for all six project cycles.

Order of Project	Project Cycle									
Completion in Present	2	3	4	5	6					
Cycle		Next-Avalibale Project								
1	2	3	1	5	1					
2	1	4	4	4	2					
3	3	1	5	2	3					
4	5	5	3	1	4					
5	4	2	2	3	5					

Table 7. Next-Available Project Schedule

# f. Finalized Experimental Project Profile

The final project profile, which incorporates next-available project assignments and their respective undersizing levels, is presented in Table 8. All experiments follow this project-order and undersizing arrangement (when applicable). While project team assignments in other than the initial project cycle may vary under different exercise scenarios, depending on calculated total development schedule values, the follow-on project order and underestimation levels of Table 8 remain fixed in all cases. Figure 1 displays a representative Total Development Schedule for all five project teams over six project cycles, applying the experimental project profile.

5	4	3	2		Team	
5	4	3	2	1	Project Number	Project C
_	5	3	2	4	Undersize Level	ycle One
4	5	3	1	2	Project Number	Project C
3	5	2	-	4	Undersize Level	ycle Two
5	2	_	ω	4	Project Number	Project C
3	1	5	4	2	Undersize Level	Project Cycle One Project Cycle Two Project Cycle Three Project Cycle Four Project
3	2	5	-	4	Project Number	Project C
_	5	2	ω	4	Undersize Level	ycle Four
_	3	2	4	5	Project Number	Project C
2	5	ω	_	4	Undersize Level	ct Cycle Five Project Cycle Six
5	4	ω	2	_	Project Number	Project (
_	S	3	2	4	Undersize Level	Cycle Six

Table 8. Final Experimental Project Profile

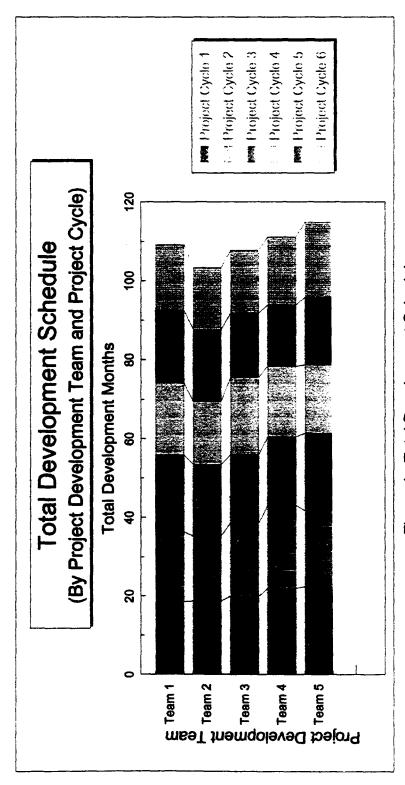


Figure 1. Total Development Schedule

## 4. Learning

The effects of "learning" on software estimation and productivity are an important element of this research. It is reasonable to assume that the effect of experience and increases in project familiarity should be reflected in higher productivity. In an attempt to model the rate of learning improvement, a plan involving the incremental increase of a related SD simulator input variable was developed.

In the SD model, nominal productivity is defined as one task per man-day. A task is any arbitrary unit by which a software project may be measured (Abdel-Hamid and Madnick, 1991, p. 80). In our experimentation vehicle, a "task" is defined in terms of a discrete number of Delivered Source Instructions, hence the SD input parameter Delivered Source Instructions per Task (DSIPTK). Consequently, an appropriate increase in DSIPTK over the nominal simulator value as projects are developed, can effectively model the 'learning curve' effect we are searching for.

For purposes of this experiment, we assume that "learning" is reflected in a 10-percent annual increase in DSIPTK. While total project development schedules obviously vary, an 18 to 24-month timeframe represents a reasonable estimate of duration for the hypothetical projects as defined. Consequently, a 20-percent increase in DSIPTK was applied to each project cycle beginning with project cycle two. This value is consistent with research findings and industry experiences (Aron, 1976). Hence, the learning scenario is defined as an incremental increase of DSIPTK from 100 percent of

nominal value to 200 percent of the nominal SD simulator value over the six project cycles. Table 9 demonstrates how the learning scenario was applied.

Project Cycle	DSIPTK: Percent of Nominal Value		
1	100%		
2	120%		
3	140%		
4	160%		
5	180%		
6	200%		

Table 9. Learning Scenario

# 5. Conventional COCOMO Calibration Strategy

"Calibration" is one method by which an organization may tailor a software cost-estimation tool to more accurately reflect its unique software development experiences. Boehm asserts that calibration of COCOMO may be necessary, for various reasons, to provide an organization with the best estimation accuracy "fit". He offers a technique for calibrating the constant term in the COCOMO nominal effort equation, and this procedure will be replicated as part of the experiment, and throughout the thesis will be referred to as the "conventional" calibration strategy.

Having selected the Basic COCOMO model and the organic mode as the most appropriate software development mode for our hypothetical organization, the calibration methodology is straightforward. Table 10 presents the Basic COCOMO effort and schedule equations for the organic mode. A few terms require definition in

understanding these equations. Under the Effort column, "MM" refers to the number of man-months estimated for the software development phase. One man-month is equal to 152 hours of working time. Under Schedule, "TDEV" is the number of estimated months for software development.

Mode	Effort	Schedule	
Organic	$MM = 2.4 (KDSI)^{1.05}$	TDEV = 2.5 (MM) <sup>0 18</sup>	

Table 10. Basic COCOMO Effort and Schedule Equations (Organic Mode)

The constant term in the effort equation above (2.4) is the value which is calibrated. Because of the absence of cost driver attributes in Basic COCOMO, the optimal coefficient may be calculated using the following equation:

$$\widetilde{C} = \frac{\sum_{i=1}^{n} MM_{i}(actual) * Q_{i}}{\sum_{i=1}^{n} (Q_{i})^{2}}$$
(2.1)

In the above equation, MM<sub>i</sub>(actual) is the actual development effort of the software project. In our experiment, this value is generated by the SD simulator, based on input values which include the Basic COCOMO effort and schedule estimates. The variable Q<sub>i</sub> for organic mode re-calibration, is defined as the actual size of the project (KDSI(actual)) raised to the power 1.05. Having determined these values, the calibration process continues by multiplying MM<sub>i</sub>(actual) times Q<sub>i</sub> for each project. The summation of this product is determined for the number of projects being factored in to the re-calibration (n). This value forms the numerator of the re-calibration equation. The denominator is calculated by first squaring each Q<sub>i</sub> value, then summing these values. The resultant coefficient represents the derived optimal constant term and replaces the organic

COCOMO coefficient value of 2.4 for estimation of the next series of (n) projects.

Chapter IV provides additional clarification of the calibration methodology using exercise data.

# 6. Alternative "Normalization" Calibration Strategy

Boehm commented on a comparative analysis of software cost models, that "...Not too surprisingly, the best results were generally obtained using models with calibration coefficients against data sets with few points...." (Boehm, 1984, p. 18). A similar analysis of the validity of the assumptions upon which calibration strategies are based, and their impact on software estimation model performance has received considerably less attention.

Basic COCOMO embraces the assumption that historical project results represent the preferred and most reliable benchmarks for future estimation purposes. This experiment challenges that notion, and seeks to validate the work of Abdel-Hamid by using the SD model as an experimental vehicle to demonstrate why this assumption is flawed (Abdel-Hamid, 1990, p. 79).

Using data from a real software project conducted by NASA, Abdel-Hamid conducted two experiments as part of SD model validation. The first experiment investigated one of two fundamental assumptions upon which conventional calibration strategies are based. That is, a project's final results are independent of its initial estimation values. His research findings indicate that different estimates do, indeed, create different projects. He reported that initial project effort and schedule estimates

significantly influence work force level decisions, productivity, work intensity, and communication and training overheads. Clearly, acceptance of these findings leads to rejection of the convention that actual project results provide the best information for future estimation activities.

Abdel-Hamid's second experiment sought to further refute the notion that raw historical project values should be the "data of choice" for both the calibration and ex-post-facto evaluation of estimation tools. Again, using the NASA data, he reported how the initial 35-percent size underestimation lead to a corresponding underestimate of project effort and duration. He observed how learning, in the form of increased project familiarity and experience, lead to the discovery of overlooked tasks, which in turn resulted in a dramatic "staff explosion" late in the development cycle, in order to meet a rigid deadline. At this point, the representativeness of NASA's actual project cost as the basis for future effort estimation becomes suspect due to the problematic nature of the project. A new project of similar size and scope, but more accurately sized at the outset, and consequently more effectively staffed, should result in project costs somewhat less than the actual results of NASA's troublesome effort.

In his work, Abdel-Hamid outlines a "normalization" strategy for eliminating inefficiencies due to initial project undersizing which incorporates the capabilities of the SD simulator. Much of this research work is aimed at examining and testing this strategy against the conventional calibration strategy under a variety of conditions and scenarios.

In theory, the normalization strategy seeks to determine the extent of man-day excesses, and adjust the archived calibration/estimation values accordingly. Figure 2 diagrams both the current calibration practice and the proposed normalization strategy.

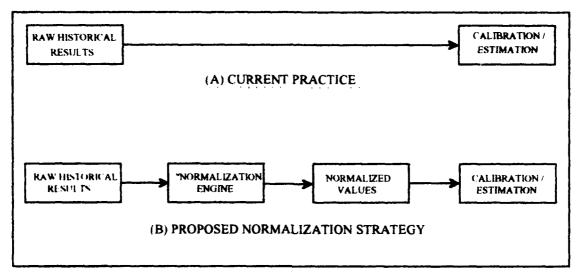


Figure 2. (a) Current Practice: (b) Proposed Normalization Strategy

To determine the normalized cost value, a project must be re-simulated with no undersizing. Optimization of cost savings is determined by repeated simulations in which actual project size and schedule inputs are fixed, while effort inputs are systematically reduced until further input reductions begin to yield higher cost outputs.

The input and output values generated during a typical normalization process are presented in Table 11. Repeated simulations in which actual project effort (MM(est)) is systematically reduced with each simulation, yields a series of actual costs (MM(act)). The shaded cell in Table 11 is the lowest numerical result generated by the SD simulator under all input conditions. This represents the project's "normalized" man-month value

and reflects the optimum cost savings achievable in a perfectly-sized project. The estimated versus actual cost values of Table 11 are graphically represented in Figure 3 to further illustrate the normalization process

	Cycle #1, 1	Project #1	
KDSI (est)	TDEV (est)	MM (est)	MM (act)
40	18.5	120.9	120.6
40	18.5	115	115.3
40	18.5	110	114.6
40	18.5	105	113.4
40	18.5	100	112.7
40	18.5	95	112.6
40	18.5	90	112.7
40	18.5	85	113.3
40	18.5	80	115.4

Table 11. Normalization Values

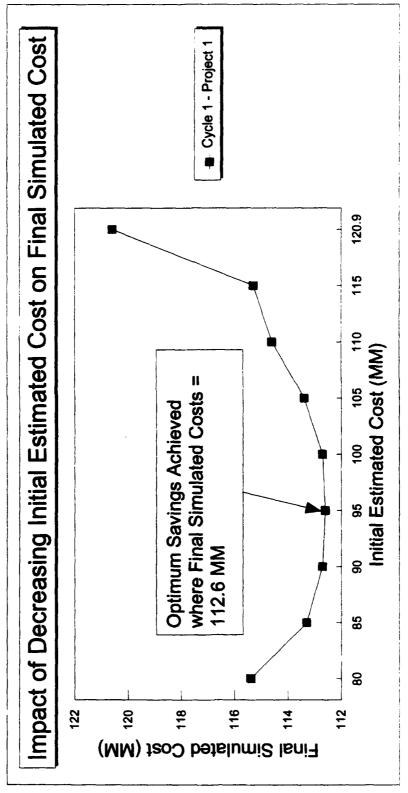


Figure 3. The Normalization Process

## III. CONDUCTING THE EXPERIMENT

### A. EXPERIMENTAL SETTING

All experiments involve extensive simulation modeling and cost estimation calculations. In addition, archiving requirements for a significant volume of generated data is necessary, as well as relational processing capabilities to conduct comparative analysis of the findings. These requirements were satisfied, and the experimental tasks successfully accomplished on an IBM-compatible 486-DX2/66 personal computer (PC).

The System Dynamics (SD) simulator runs in the MS-DOS environment, however the PC was configured to run the application in a window of Microsoft Windows 3.1, to facilitate transfer of information. User interface is via the keyboard. Figure 4 is the "changes" screen, where input parameters are entered to examine the various exercise scenarios. Of note, the fields routinely used in experiment simulations are found on this screen such as DSIPTK and UNDEST (first column), TOTMM (second column), and TDEVI (third column). A tailored report is also generated for each completed simulation, and provides not only a convenient presentation of simulation results, but also displays initial input parameters to permit easy verification of data entry. A copy of one such report is presented in Figure 5.

An electronic spreadsheet, specifically Lotus 1-2-3, release 4.1 for Windows, was chosen as the appropriate application for managing and presenting the experimental data. It offers advanced spreadsheet, charting, drawing, scenario and database features which

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TSAEDS=	40.	TSTOVE=	1.	TSTSPD=	56.	UNDESM=	6
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Figure 4. SD Simulator "CHANGES" Screen

INTITIAL ESTIMATES:		
Project Size Project Cost Project Duration	24.0 127.3 12.6	KDSI Person-Months Months
FINAL PROJECT RESULTS:  Actual Project Size Total Man-Mouths Completion Time	40.0 161.7 15.3	KDSI Man-Months Months

Figure 5. Tailored Simulation Report

were extremely valuable tools in conducting, analyzing, documenting and presenting the results of the experiment.

#### **B. RELATED EXPERIMENTAL TASKS**

With a clear statement of the experimental objective, appropriate choice of experimentation vehicles, and a valid experiment design, several administrative tasks remain to facilitate conducting the experiment and handling the data. Important to this pre-execution phase is the development of a number of worksheet templates in Lotus 1-2-3. The "calculations worksheets" are of particular value -- project profile data and simulated project cost data are directly entered here. Incorporated within the calculations worksheets are numeric cell formulas and interrelationships such that upon appropriate entry of project data, key dependent values are automatically calculated. Figure 6 is an example of a calculations worksheet. A detailed explanation of the calculations worksheet's operation is presented with the research findings in Chapter IV.

In addition, a number of tailored spreadsheet tables were developed to archive, perform comparative analysis on, and display the collected data in a consolidated, readable format. Appendix B is an example of this type of tailored spreadsheet table.

#### C. DEPENDENT MEASURES

Answering the research question requires capturing key simulation and computational data on project performance and productivity. These values are absolutely essential to meaningful analysis and interpretation of the research findings. Each of these values is

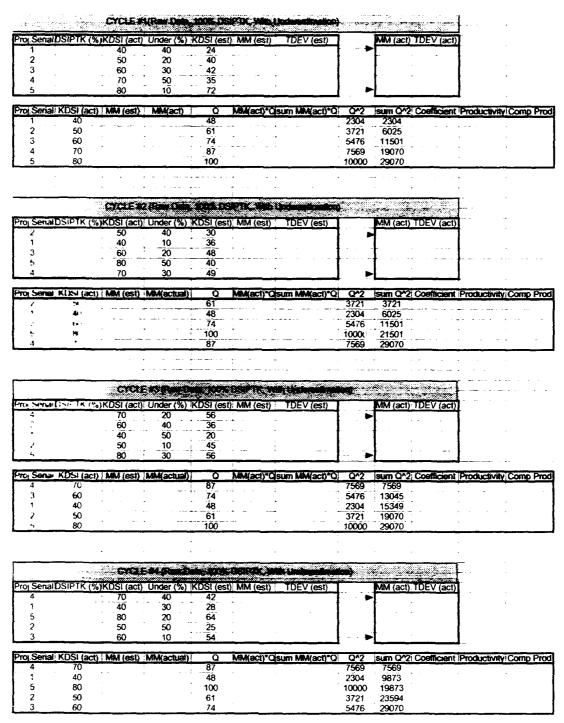


Figure 6. Research Calculations Worksheet (Lotus 1-2-3)

described below; parenthetical text following each heading reflects the abbreviation used for this value throughout the thesis:

## 1. Actual Project Effort (MM(act))

Actual Project Effort is one of the dependent variables generated by the SD simulator, and represents the number of actual man-months required for the software development phase of each individual project.

## 2. Actual Project Schedule (TDEV(act))

This value is also a dependent variable generated by the SD simulator, and represents the actual number of months required for completion of the software development phase of each individual project.

# 3. Actual Project Productivity (*Productivity*)

Actual Project Productivity is an important metric by which competing calibration strategies are compared and evaluated. It is calculated by dividing the actual project size (KDSI(act)) by the actual project effort (MM(act)). This value is calculated ex-post-facto for each individual project. It is expressed as a decimal value, and there is an inverse relationship between actual project effort and actual project productivity.

## 4. Composite Cycle Productivity (Comp Prod)

Composite cycle productivity is a deterministic value which reflects the combined productivity of all five projects as defined in a particular project cycle. It is calculated by dividing the total actual size of all projects in the cycle (summation of KDSI(act)), by the total actual effort of all projects (summation of MM (actual)). Since the total actual size of all projects in each cycle is fixed (300 KDSI), composite productivity is driven by the

value of total project effort -- the lower the total effort, the higher the composite productivity.

## 5. Average Staff (Avg Staff)

This value represents the average staffing level for each project. The accurate projection of required staff levels is a critical function in software development. Average Staff is calculated in COCOMO by dividing the actual project effort (MM(act)) by the actual project schedule (TDEV(act)).

## 6. Normalized Project Effort (MM(norm))

Normalized Project Effort is the value resulting from the application of the normalization process, described in detail in Chapter II, to Actual Project Effort (MM(act)). Its value represents an optimal achievable level of project effort and forms the basis for calculation of the COCOMO Calibration Coefficient in the alternative calibration strategy which is examined in this experiment.

# 7. COCOMO Calibration Coefficient (Coefficient)

"Calibration" is one method by which an organization may tailor a software cost estimation tool to more accurately reflect its unique software development experiences. "Coefficient" refers to the constant term in the COCOMO nominal effort equation, and its calculated value is critical to subsequent model estimation accuracy. The central issue in the evaluation of the conventional versus the alternate (normalized) calibration strategies involves the appropriateness of the independent variable upon which the coefficient calculation is based. In the conventional calibration strategy, it is based on

actual project effort (MM(act)), while the normalized calibration strategy bases its computation on normalized project effort (MM(norm)).

#### D. ORGANIZING THE EXPERIMENT

The experiment is conducted in four phases. Presented in this section of the report are the research objectives of the various experiments, an explanation of how each phase is organized, and a general explanation of the exercise "flow". Detailed process definitions are presented along with the experimental results and analyses in Chapter IV.

#### 1. Phase One

The objective of this phase is to compare the simulated project cost results obtained by applying the conventional software estimation tool calibration strategy, against a similar set of cost values obtained by applying the normalized calibration strategy. Both learning and undersizing are assumed in this scenario. The project profile determines the project-set order and undersizing allocation for each of the six project cycles. The SD simulator and COCOMO equations are used to both replicate the conventional calibration strategy and test the alternative normalization strategy. Key computational values (Dependent Measures) are captured, and a comparative analysis of the two calibration strategies is offered. The data set collected in Phase One constitutes the "base case" results, against which all other scenarios are tested.

#### 2. Phase Two

In Phases Two through Four, the experiment is structured to perform sensitivity analysis on the base case results. Different assumptions and environmental factors are examined by using the SD simulator's ability to change one input variable while holding

all others constant. In each scenario, particular attention is paid to the effects of "normalization", vis-a-vis the conventional calibration strategy, on the experimental results

The objective of Phase Two is to examine the effects of size underestimation on base case results. A new case is developed where learning is assumed, but <u>no size underestimation</u>. Simulated results for the same project set are calculated, applying both the conventional and normalized calibration strategies, and compared with base case findings. All other conditions are identical to those in Phase One.

#### 3. Phase Three

The objective of Phase Three is to examine the effects of learning on base case results. A new case is developed where undersizing is assumed, but <u>no learning</u>. Simulated results for the same project set are calculated, applying both the conventional and normalized calibration strategies, and core pared with base case findings. All other conditions are identical to those in Phases One and Two.

#### 4. Phase Four

The objective of Phase Four is to examine the impact of overestimation and underestimation of productivity on project-set results. In this scenario, we again assume undersizing and no learning, as in the previous experiment. However, this experiment explores the effect of misrepresenting productivity as a function of how the level of effort associated with the accomplishment of a software development "task" is defined within the organization.

Central to the productivity overestimation/underestimation question is the notion of "variable task definition." Disparate definitions of the effort required to accomplish a software task may account for situations where various software development organizations require different levels of development effort to design and code projects of similar size and scope. In projects where the number of delivered source instructions is identical in each organization, the value of "task" becomes the determinant with regard to measuring effort, and hence, productivity. First, this experiment re-simulates the project set and examines the impact of underestimating productivity by a factor of 75 percent of the nominal case. Next, the project set is re-simulated, this time overestimating productivity by a factor of 125 percent of the nominal case. The results are compared to Phase Three, which models the nominal case in this scenario (undersizing, no learning, and "perfectly-represented" productivity).

## IV. EXPERIMENTAL RESULTS AND ANALYSIS

#### A. INTRODUCTION

The SD simulation model generated raw data on the actual cost and schedule for each simulated project. The manner in which these values are applied in calibrating the CO-COMO software estimation tool, and its impact on productivity and cost savings under a series of conditions are the central focus of this analysis. As such, there are four principal areas of investigation. First, the replication of a conventional software estimation tool calibration strategy using raw cost data and assuming both learning and undersizing, is compared with an alternative calibration strategy using normalized cost data under the same assumptions. Nexal asse-case results of phase one are compared with simulated results of a new case assuming learning but no undersizing. The third area of investigation is a comparison of the base-case results with a new case in which there is undersizing, but without learning effects. Finally, the impact of both underestimation and overestimation of productivity on the results obtained in the scenario with undersizing and without learning is examined.

# B. CONVENTIONAL VS. ALTERNATIVE CALIBRATION STRATEGIES WITH LEARNING AND UNDERSIZING (BASE CASE)

## 1. Assumptions

## a. Underestimation of Project Size

The Basic COCOMO schedule estimation model requires as its single input, a user-provided estimate of the project's size in thousands of delivered source instructions (KDSI). Consequently, an inaccurate size estimate input will result in a similarly imprecise schedule estimation output. The inclination toward project size underestimation is not uncommon throughout the software industry (Boehm, 1981, p. 320). For purposes of this experiment, size underestimation, when applied, is represented as a percentage of actual project size. Undersizing is assumed to range from 10 percent to 50 percent, in 10-percent increments, and is applied to individual project serials in accordance with the project/cycle profiles presented in Chapter II. The undersizing percentages, expressed in decimal notation, are subsequently applied as the SD simulator input parameter UNDEST.

# b. The Effects of "Learning" on Software Estimation and Productivity

By "learning" we mean increases in productivity. This learning happens as an organization gains experience in developing its type of software and as it incorporates new software development tools. As discussed in Chapter II, we assume that "learning" is reflected in a 10-percent annual increase in the SD simulator input parameter *Delivered Source Instructions per Task* (DSIPTK). Consequently, with project schedules generally

approaching two years' duration, a 20-percent increase in DSIPTK was applied to each project cycle beginning with project cycle two. Therefore, the learning scenario is defined as an incremental increase of DSIPTK from 100 percent to 200 percent of the nominal value over the six project cycles.

# 2. Conventional Calibration Strategy

Five synthetic project serials were simulated over six organizational project cycles, for a total of 30 simulations. Key computational values, as defined in Chapter III, were calculated and tracked throughout the experiment. They include Actual Project Effort (MM(actual)), Actual Project Schedule (TDEV(act)), COCOMO Calibration Coefficient (Coefficient), Actual Project Productivity (Productivity), Composite Cycle Productivity (Comp Prod), and Average Number of Staff Required (Avg.Staff). Appendix A presents all calculations and data used to generate these key values, which are further consolidated and summarized in Table 12.

The methodology for determining actual simulated values will be described as the process unfolds in Appendix A. In the following discussion, descriptive abbreviations in parenthesis correspond to column labels in Appendix A. For each project serial (Proj Serial), a learning value (DSIPTK (%)) is assigned. A project size estimate (KDSI(est)) is determined by multiplying the actual project size (KDSI(act)) times the size underestimation percentage (Under (%)). Using this project size estimate (KDSI(est)) as the input variable to the organic COCOMO formula, the estimated project effort

11.5	0.311	0.28	2.62	21.1 21.8	252 9 250 1	80	15 20	111.2 237.2	35 72	(J 4)
0 4 C		0 0 0		18	150.4	38	5 55 K	12 2 7	4 6 6	ω <b>Ν</b> Ι-
≱	Comp Prod	Productivity	Coefficient	TDEV(act)	MM (actual)	KDSI (act)	TDEV (est)	MM (est)	KDSI (est)	Pro Serial
	3	SIMULATED	CYCLE #6 (ACTUALS -	CYCLE #6				(ESTIMATES	CYCLE #6 (E	•
7	0.308	0.34	2.66	16.9	117 6	40	14.4	99.7	32	- (
300		0.33		3 6	203.5	3 0	14.9	109 5	3 6	<b></b>
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≥	Comp Prod	Productivity 0.28	Coefficient	TDEV(act)	MM (actual)	KDSI (act)	TDEV (est)	MM (est)	KDSI (est)	Prol Serial
	¥	SIMULATED	(ACTUALS -	CYCLE #5			)	(ESTIMATES)	CYCLE #5 (E	۰
9.4	0.311	0.33	2.62	18.3	181.5	60	17.8	174	54	u
8.4		0.3		18.6	165	50	13 1	77.5	25	N
11.9	:	0.34		21.6	257.4	8 8	10	208	212	On: -
11.7		0.29		20.7	242.2	70	6	133.7	3 25	4
Ą	Comp Prod	Productivity	Coefficient	TDEV(act)	MM (actual)	KDSI (act)	TDEV (981)	MW (981)	KDSI (est)	Pro Serial
	3	SIMULATED	(ACTUALS -	CYCLE #4				(ESTIMATES)	CYCLE #4 (E	0
12.8	0.308	0.29	2 64	21.4	273 1	80	18.2	187	56	<b>σ. ν</b>
9 00	-	032		18.4	124.8	6.5	12	63.4	à: 23	<u></u> د
10.2		03		10.5	198.6	80	5 3	117.6	နှင့်	ω.
d Avg. Staf	Comp Prod	Productivity	Coefficient	TDEV(act)	MM (actual)	KDSI (act)	TDEV (est)	MM (981)	KDSI (est)	Proj Serial
		SIMULATED	(ACTUALS -	CYCLE #3				(ESTIMATES)	CYCLE #3 (E	١
=	0.302	0.31	2.73	20.6	227.4	70	16.9	152.4	49	۵
137	;	0.26		223	305	8 8	တ် တ	123	8 8	UT (
0,7		0.33	1	- - - - - - -	115.7	8 6	14.9	1102	36	<b>.</b> . ⊶
		0.31		19.2	160.3	95	13.9	91	30	2
d Avg. Stat	Comp Prod	Productivity	Coefficient	TDEV(act)	MM (actual)	KDSI (act)	TDEV (est)	MM (est)	KDSI (est)	Pro Serial
	3	CYCLE #2 (ACTUALS - SIMULATED	(ACTUALS -	CYCLE #2				(ESTIMATES)	CYCLE #2 (E	^
10.9	0.317	0.33	2.56	22.3	242.3	80	19.2	214	72	5
11.2		0.28		21.9	245.8	70	14.4	100 3	35 i	٠ ڪ
9 a		0 0 33 55	:	9 0	1876	8 8	5 0	121 5	\$ 8	ω ٨
6.5		0.33	:	85	120.9	40	12.4	67.5	24	· (
d Avg. Staf	Comp Prod	Productivity	Coefficient	TDEV(act)	MM (actual)	KDSI (act)	TDEV (est)	MM (est)	KDSI (est)	Prof Serial
	3	CYCLE #1 (ACTUALS - SIMULATED)	(ACTUALS -	CYCLE #1				ESTIMATES	CYCLE #1 (ESTIMATES	

Table 12. Conventional Calibration Strategy

(MM(est)) and estimated project schedule (TDEV(est)) are determined. All required input parameters for the project simulation have now been calculated. They are, KDSI(act), DSIPTK (%) — expressed as a numerical value based on the nominal simulator value of 60, Under (%) — expressed as a decimal value, MM(est), and TDEV(est). Next, the SD simulator generates the actual effort (MM(act)) and actual schedule (TDEV(act)) values.

The second series of calculations presented in each project cycle in Appendix A, uses the simulated actual effort and schedule values of each of the five project serials to determine the COCOMO calibration coefficient (Coefficient) which will be applied to all projects in the subsequent project cycle. Coefficient calculation is based on a series of well-defined computations as described in Chapter II. In the case of project cycle one, the Coefficient of 2.56 reflects an upward adjustment from the organic COCOMO value of 2.4. If this "conventional" calibration strategy is effective, this higher value, when applied to project cycle two size estimations, should produce more accurate effort and schedule estimates. Figure 7 shows the movement of the COCOMO calibration coefficient over the six project cycles under the conventional calibration strategy.

In addition, actual project productivity (Productivity) and composite cycle productivity (Comp Prod) are also determined in Appendix A. Actual project productivity (Productivity) is defined as the actual size of the project (KDSI(act)) divided by the actual cost of the project (MM(actual)). Results of the experiment are displayed in Figure 8, and reflect individual project productivities between .27 and .43.

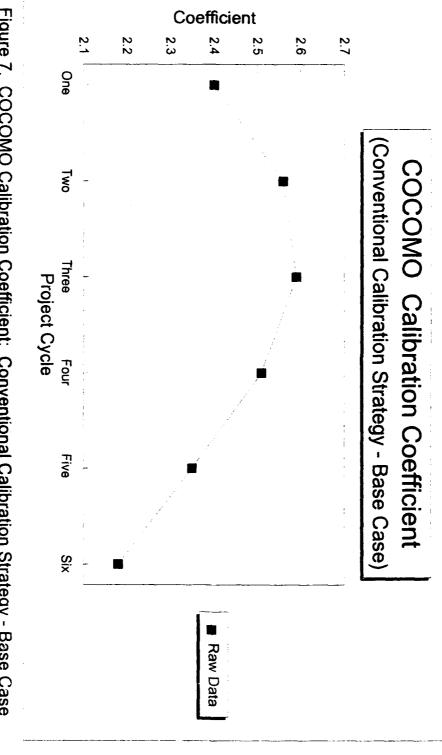


Figure 7. COCOMO Calibration Coefficient: Conventional Calibration Strategy - Base Case

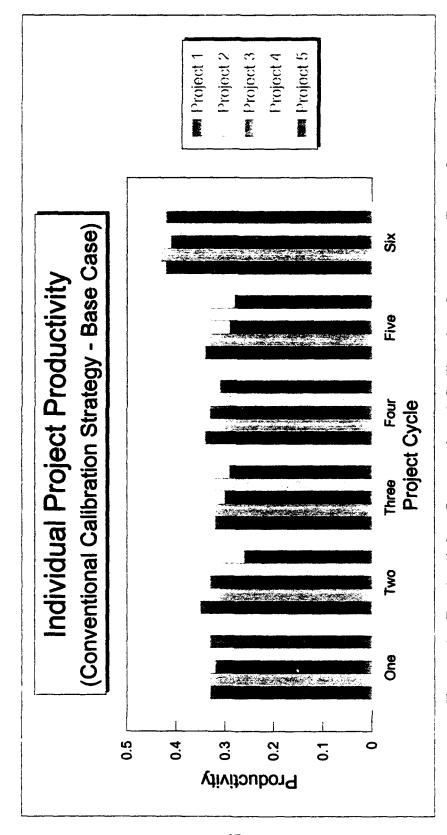


Figure 8. Productivity: Conventional Calibration Strategy - Base Case

Composite cycle productivity is defined as the total actual size of all projects in the cycle ( $\sum$ KDSI (act)), divided by the total actual effort of all projects ( $\sum$ MM (act)). In the conventional calibration scenario, overall composite productivity of the software development organization through the six project cycles improved from .317 to .411 (29.65 percent). Figure 9 captures this upward movement of composite productivity.

## 3. Alternative Calibration Strategy

The methodology employed in applying the alternative calibration strategy is identical to the conventional strategy described in the previous section, with one important exception. As described in Chapter II, upon determination of actual cost and schedule values using conventional COCOMO techniques, the projects are re-simulated with actual size and actual schedule inputs fixed. Cost estimates are gradually reduced from the actual simulated value until the optimum savings, or "normalized" cost value, is achieved. Appendix B provides all data on the normalization process for each of the five project serials over the six project cycles. Shaded cells in the MM(act) column represent the optimum or "normalized" value for that particular project. This value, referred to as MM(norm), is incorporated in the organizational data base and is used to calculate the new COCOMO calibration coefficient. Appendix C presents all calculations and data associated with the calibration of COCOMO using normalized data. Note its similarities with Appendix A. However, in the second series of calculations for each project cycle, the normalized effort (MM(norm)) is a new column entry. Its value was computed as part of the normalization process and transferred directly from the shaded cells in

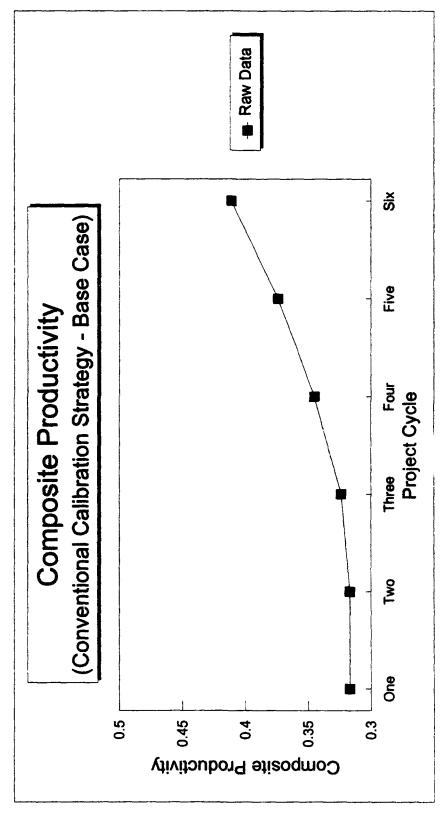


Figure 9. Composite Productivity: Conventional Calibration Strategy - Base Case

Appendix B. It is this value, MM(norm), which generates the new COCOMO coefficient, and not the actual effort cost value (MM(act)), as in the conventional calibration strategy.

It is important to note that normalization of the effort cost data has no *direct* impact on project productivity or composite cycle productivity, as <u>actual</u> effort costs continue to be used in computing these values. Normalization is primarily a process by which the inefficiencies which have plagued a problematic software development project can be eliminated. In so doing, it is possible for an organization to optimize the accuracy and representativeness of archived data for future estimation of similar projects.

A by-product of the normalization process, however, is improved productivity. In theory, normalization provides the organization with more optimal calibration coefficients which should lead to more optimal estimations. As inefficiencies are eliminated in project estimation, simulations produce projects with lower actual costs, which in turn, lead to improved productivity. These notions are borne out in the experimental findings summarized in Figure 10 and Table 13 — a comparison of the previously-determined raw historical data with the normalized data recorded upon re-simulation of the identical project set. Improvement percentages for normalized data versus raw data are calculated in Table 13 for actual cost, productivity, and composite productivity values. Note that beginning with project cycle two (when the normalization process first produces a unique calibration coefficient), improvement is noted across all entries. While improvements

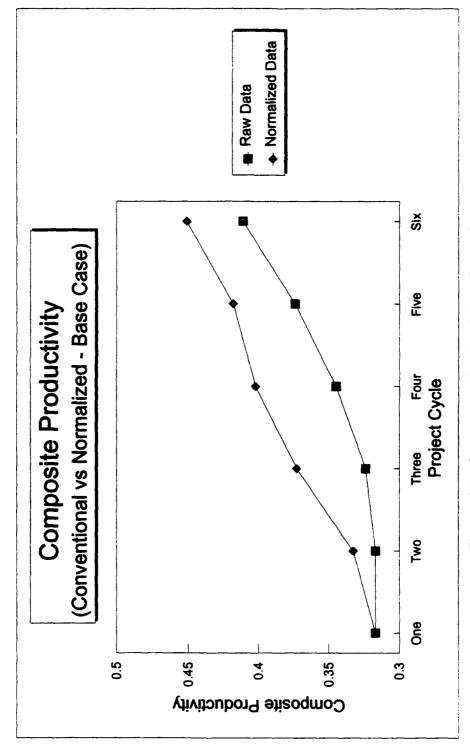


Figure 10. Composite Productivity - Base Case

Cycle	Cycle & Project	i	Raw	Raw Data			Normalia	Normalized Data		Perce	Percent Improvement	ment
Cycle #	Project #	DSIPTK (%)MM (act)		Productivity Comp. Prod DSIPTK (%)MM (act)	Comp.Prod	DSIPTK (%	MM (act)	Productivity Comp.Prod	Comp.Prod	MM (act)	Productivity Comp.Prod	Comp.Prod
-	-3	100%	[	0.33		100%	120.9	0.33		0.00%	0.00%	
	~	100%		0.33		100%	9.7	0.33		0.00%	0.00%	
_	3	100%	187.6	0.32		100%	187.6	0.32		0.00%	0.00%	
_	4	100%	245.8	0.28		100%	245.8	0.28		0.00%	0.00%	
-	St.	100%	242.3	0.33	0.317	100%	242.3	0.33	0.317	0.00%	0.00%	0.00%
2	N	120%	147.3	0.34		120%	142.7	0.35		3.12%	2.94%	
2	_	120%	117.7	0.34		120%	107.6	0.37		8.58%	8.82%	
2	3	120%	178.6	0.34		120%	165.9	0.36		7.11%	5.88%	
2	5	120%	291.4	0.27		120%	277.9	0.29		4.63%	7.41%	
2	4	120%	209.9	0.33	0.317	120%	207.7	0.34	0.333	1.05%	3.03%	5.05%
ω	4	140%	216.5	0.32		140%	182.1	0.38		15.89%	18.75%	
ယ	ယ	140%	189.2	0.32		140%	164.8	0.36		12.90%	12.50%	
ယ	-	140%	123.1	0.32		140%	104.6	0.38		15.03%	18.75%	
ω	2	140%	147	0.34		140%	122.7	0.41		16.53%	20.59%	
ယ	CT.	140%	251.2	0.32	0.324	140%	229.9	0.35	0.373	8.48%	9.38%	15.12%
4	4	160%	212.1	0.33		160%	188	0.37		11.36%	12.12%	
•		160%	111.1	0.36		160%	92.3	0.43		16.92%	19.44%	
4	Ø1	160%	233.8	0.34		160%	199.9	0.4		14.50%	17.65%	
4	2	160%	146.9	0.34		160%	128	0.39		12.87%	14.71%	
4	w	160%	165.7	0.36	0.345	160%	138.5	0.43	0.402	16.42%	19.44%	16.52%
CII	5	180%	225.9	0.35		180%	215.1	0.37		4.78%	5.71%	
ن. ت	4	180%	180	0.39		180%	154.4	0.45		14.22%	15.38%	
C)Ti	2	180%	130.6	0.3%		180%	111.6	0.45		14.55%	18.42%	
C)1	3	180%	165.3	0.36		180%	151.9	0.39		8.11%	8.33%	
<b>U</b> r		180%	100.5	0.4	0.374	180%	85.1	0.47	0.418	15.32%	17.50%	11.76%
6	-	200%	95.3	0.42		200%	84.1	0.48		11.75%	14.29%	
G	2	200%	117.2	0.43		200%	103.2	0.48		11.95%	11.63%	
O	ယ	200%	145.8	0.41		200%	130.9	0.46		10.22%	12.20%	
O.	4	200%	180.5	0.39		200%	176.6	0.4		2.16%	2.56%	
6	5	200%	191.7	0.42	0.411	200%	170	0.47	0.451	11.32%	11.90%	9.73%

Table 13. Comparison of Conventional and Normalized Calibration Strategies - Base Case

are noted in productivity values associated with both raw and normalized data, the more dramatic results achieved through data normalization is apparent.

Of particular significance is the improvement in composite cycle productivity evident within both the raw and normalized data sets themselves. Over the course of the six project cycles, composite productivity, as determined under the conventional calibration strategy improved by 29.65 percent (from .317 to .411). Even more impressively, under the normalization strategy, composite productivity values improved by 42.27 percent (from .317 to .451). Recalling that in this scenario, experimental assumptions include both learning and undersizing, it is logical to pursue investigation of alternative scenarios in an effort to isolate and examine the effects of these assumptions.

The proper use of normalized effort cost data can have a significant impact on future software development costs. Table 14 summarizes actual project effort (MM(act)) under both the conventional and normalized calibration strategies. In addition, the table includes information on *potential* savings which may be achieved by archiving normalized data in the organizational data base vice the actual cost data. These savings could result when, in the future, the organization is faced with estimation of a project of similar size and scope. By using normalized data as input, estimates would not be biased by the inefficiencies which plagued the previous project. The potential savings in our problem set are noteworthy, both in terms of real effort cost savings (2.2 to 34.4 man-months) and percentage of reduction in cost (1.05 to 16.92 percent). Figure 11 graphically represents

Cycle a	nd Project I	nformation	Actual Pro	oject Effort		Potential Savings Through	
			Conventional	Normalized	Norm	nalization	
Cycle #	Proj.Serial	KDSI (act)	MM (act)	MM(act)	MM	Percent	
1	1	40	120.9	120.9	0	0.00%	
1	2	50	149.7	149.7	0	0.00%	
1	3	60	187.6	187.6	0	0.00%	
1	4	70	245.8	245.8	0	0.00%	
1	5	80	242.3	242.3	0	0.00%	
2	2	50	147.3	142.7	4.6	3.12%	
2	1	40	117.7	107.6	10.1	8.58%	
2	3	60	178.6	165.9	12.7	7.11%	
2	5	80	291.4	277.9	13.5	4.63%	
2	4	70	209.9	207.7	2.2	1.05%	
3	4	70	216.5	182.1	34.4	15.89%	
3	3	60	189.2	164.8	24.4	12.90%	
3	1	40	123.1	104.6	18.5	15.03%	
3	2	50	147	122.7	24.3	16.53%	
3	5	80	251.2	229.9	21.3	8.48%	
4	4	70	212.1	188	24.1	11.36%	
4	1	40	111.1	92.3	18.8	16.92%	
4	5	80	233.8	199.9	33.9	14.50%	
4	2	50	146.9	128	18.9	12.87%	
4	3	60	165.7	138.5	27.2	16.42%	
5	5	80	225.9	215.1	10.8	4.78%	
5	4	70	180	154.4	25.6	14.22%	
5	2	50	130.6	111.6	19	14.55%	
5	3	60	165.3	151.9	13.4	8.11%	
5	1	40	100.5	85.1	15.4	15.32%	
6	1	40	95.3	84.1	11.2	11.75%	
6	2	50	117.2	103.2	14	11.95%	
6	3	60	145.8	130.9	14.9	10.22%	
6	4	70	180.5	176.6	3.9	2.16%	
6	5	80	191.7	170	21.7	11.32%	

Table 14. Potential Savings Through Normalization

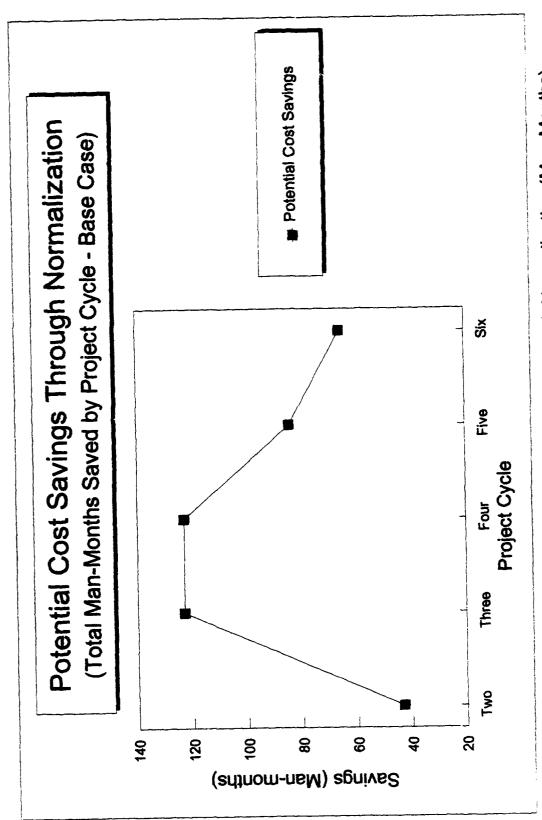


Figure 11. Potential Cost Savings Achievable Through Normalization (Man-Months)

the potential cost savings achievable through normalization of all projects, beginning with project cycle two.

These savings are possible since normalization removes the inefficiencies which lead to smaller COCOMO coefficients, which in turn, lead to "tighter" (i.e., smaller) cost estimates. On the other hand, the conventional calibration strategy produces higher calibration coefficients which subsequently lead to larger size estimates (Figure 12). As discussed in Chapter II, these higher-than-ideal estimates significantly influence the project's final results. Work expands to fill the available slack time, and the self-fulfilling prophecy of Parkinson's Law is realized once again (Boehm, 1981, p. 592).

Estimated project productivity was calculated as a measure by which the effects of project size underestimation could be observed on project behavior and outcome. Its calculation differs from that of actual productivity in that the actual size of the project (KDSI(act)) is divided by the COCOMO-generated estimate of project cost based on no size underestimation (MM(est)). With post-facto knowledge of a project's actual size, an estimated project effort value can be generated for the denominator value (MM(est)). Figure 13 plots estimated project productivity versus project size for project cycle one and both the conventional and normalized estimated productivity values for project cycle six. It is clear from the plot that estimated productivity decreases as project size increases in all three instances.

As defined, the estimated productivity value should "shadow" the actual productivity value as it relates to the COCOMO-calibrated project effort estimate. When compared

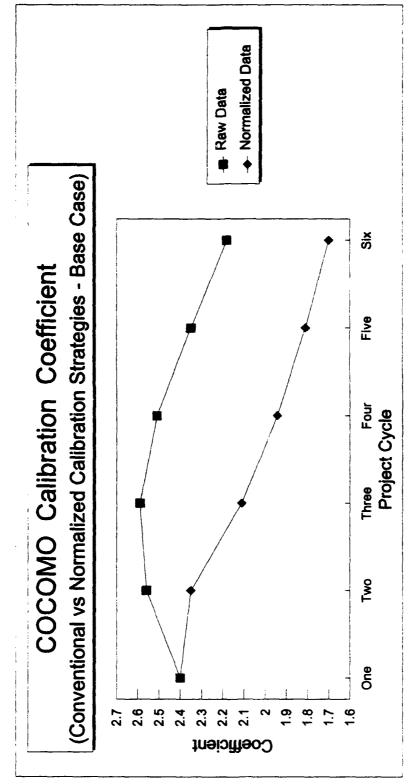
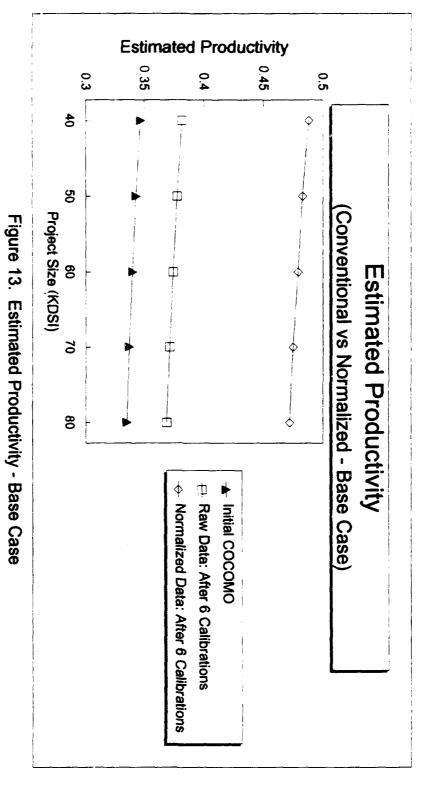


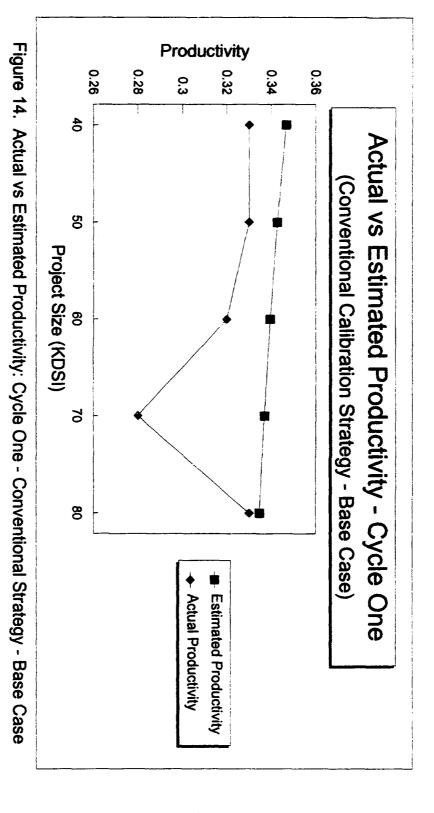
Figure 12. COCOMO Calibration Coefficient: Conventional vs Normalized - Base Case



against actual project productivity, estimated project productivity provides an indication of the relative accuracy and validity of the software estimation tool and its calibration coefficient. Figures 14, 15, and 16 compare actual versus estimated project productivity as a function of project size for project cycles one and both the raw and normalized instances of project cycle six, respectively. In Figure 14, the trend toward convergence of the actual and estimated productivity values appears loosely related to initial project undersizing. For example, the project with the smallest size underestimation (80 KDSI with 10% underestimation) has an actual productivity figure closest to its estimated productivity value. Likewise, the actual productivity of the project with the largest undersizing (70 KDSI with 50% underestimation) is furthest away from its estimated counterpart.

From Figure 13, it is evident that the conventional COCOMO calibration method has lead to estimated productivity values in project cycle six approximately 10 percent more than similar projects in cycle one. The normalization method yields values nearly 41 percent higher than cycle one. Nevertheless, from Figure 15, conventional cycle six actual productivity values exceeded their estimates by between 5.1 and 14 percent. With the exception of the largely undersized project (70 KDSI, 50-percent undersizing), the normalization strategy, shown in Figure 16, provides the best "fit", with estimated productivities exceeding actual productivities by an average of less than 1.5 percent.

This fact is also confirmed by using the completed project results for ex-post-facto evaluation of the accuracy of the COCOMO estimation model. The percentage of



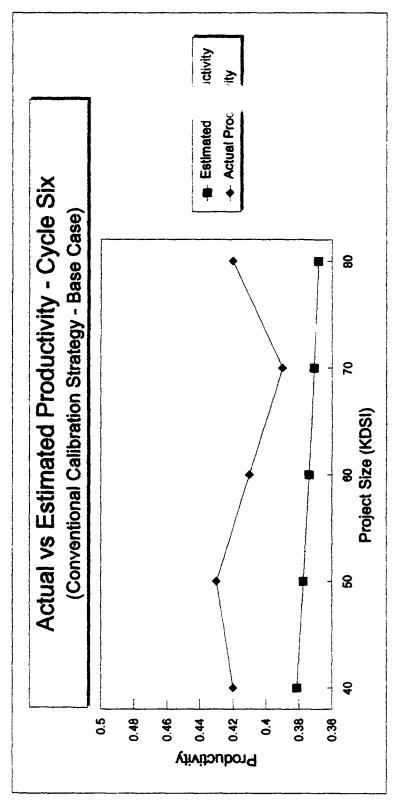
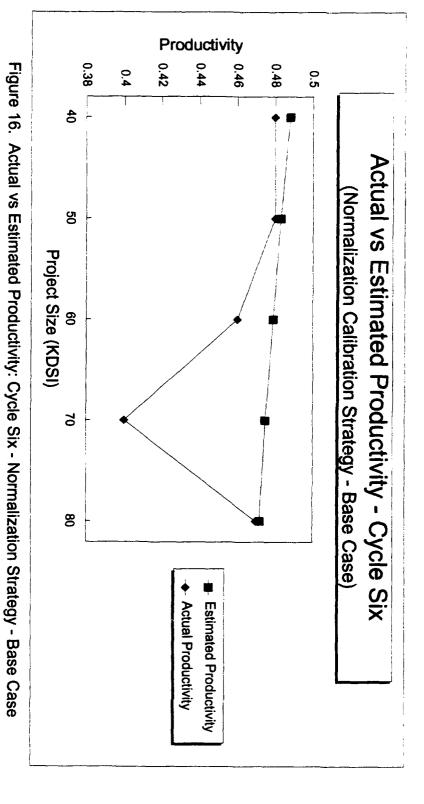


Figure 15. Actual vs Estimated Productivity: Cycle Six - Conventional Strategy - Base Case



relative error in the accuracy of project cost estimation can be caluclated using the following equation:

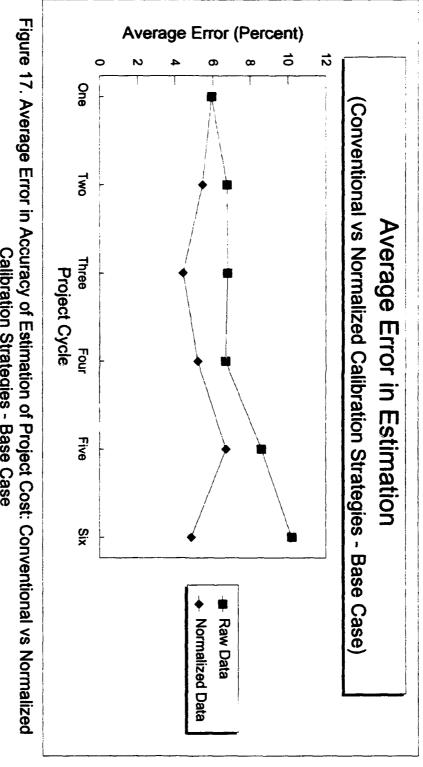
Percent Relative Error = 
$$\frac{100*|MM(act)-MM(est)|}{MM(act)}$$
 (4.1)

Equation 4.1 is used to determine the accuracy of the base case estimates generated under both the conventional and normalized calibration strategies in cycles two through six of the exercise scenario. Figure 17 is a plot of the average error for all projects by project cycle, and the results suggest that the accuracy of COCOMO project cost estimation in this scenario favors the normalized calibration model over the conventional model.

#### C. EFFECTS OF NO UNDERSIZING ON BASE CASE RESULTS

Having concluded an examination of conventional versus normalized calibration strategies in a scenario that included both learning and undersizing (base case), the project set was re-simulated under similar conditions, but assuming no undersizing. The methodology was identical to the base case, with the exception that the SD simulator input UNDEST was set at "0" in each project simulation to reflect "perfect" size estimation. Appendices D, E, and F document the results of these re-simulations, again modeling both the conventional and normalized calibration strategies. The results are summarized in Table 15.

A comparison with the base case results (Table 13) reveals some interesting findings. With no undersizing, individual productivity improved in all projects and across all project cycles with respect to their undersized counterparts. In 18 of the 30 project serials, however, the *percentage* of improvement in productivity realized through the



Calibration Strategies - Base Case

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ment	Comp.F					0.00%					3.27%					12.83%					13.78%					11.63%					8.60%
Percent Improvement	Productivity Comp. Prod	%00.0	%00.0	%00.0	%00.0	%00.0	2.94%	2.88%	2.94%	3.03%	3.03%	11.76%	14.71%	11.43%	11.43%	11.76%	13.51%	13.16%	16.67%	10.53%	13.51%	12.50%	12.50%	12.20%	9.76%	9.52%	6.52%	8.89%	8.09%	%60.6	8.30%
Perce	MM (act)	0.00%	0.00%	0.00%	%00.0	0.00%	3.33%	3.43%	3.14%	3.11%	3.15%	11.64%	11.30%	10.03%	10.68%	11.79%	12.40%	10.65%	13.43%	11.10%	11.83%	11.31%	10.70%	9.79%	10.14%	9.31%	7.18%	7.54%	7.83%	8.08%	8.72%
	Comp.Prod					0.334					0.347					0.387					0.421					0.451					0,48
Normalized Data	Productivity Comp. Prod	0.35	0.34	0.34	0.33	0.32	0.35	0.36	0.35	0.34	0.34 0.34	0.38	0.39	0.39	0.39	0.38	0.42	0.43	0.42	0.42	0.42	0.45	0.45	0.46	0.45	0.46	0.49	0.49	0.48	0.48	0.47
Normali	MM (act)	116.4	145.9	178.3	212	246.7	142.4	112.6	172.6	233.7	203.1	182.1	154.7	101.4	127.9	209.4	167.5	93.1	192.7	117.7	142.3	179.6	156.1	109.6	133	86.7	81.4	103	124.7	146.8	168.5
	DSIPTK (%)	100%	4004	100%	100%	100%	120%	120%	120%	120%	120%	140%	140%	140%	140%	140%	160%	180%	160%	160%	160%	180%	180%	180%	180%	180%	200%	200%	200%	200%	200%
	Comp. Prod					0.334					988.0					0.343					0.37					0.404					0.442
Data	Productivity Comp. Prod DSIPTK (%	0.35	0.34	0.34	0.33	0.32	₹.0	9. 2.	8.0 8.3	0.33	0.33	0.34	0.34	0.35	0.35	0.34	0.37	0.38	0.36	0.38	0.37	9.4	0.4	0.41	0.41	0.42	0.46	0.45	0.44	0.44	0.43
Raw Data	MM (act)	115.4	145.9	178.3	212	£ 348	147.3	116.6	178.2	241.2	209.7	206.1	174.4	112.7	143.2	237.4	191.2	104.2	222.6	132,4	161.4	202.5	174.8	121.5	148	95.6	87.7	111.5	135.3	159.7	184.6
	DSIPTK (%)	100%	4004	100%	100%	100%	120%	120%	120%	120%	120%	140%	140%	140%	140%	140%	160%	160%	160%	160%	160%	180%	180%	180%	180%	180%	200%	200%	200%	200%	200%
Project	Project #	1	2	3	4	2	7	1	က	သ	4	4	က	-	2	ည	4	-	2	7	3	£	4	7	က	-	-	2	3	4	2
Cycle & Project	Cycle #	-	•	-	-	-	7	2	2	7	7	ო	က	က	က	က	4	4	4	4	4	သ	သ	က	Q.	ည	စ	ဖ	စ	မှ	9

Table 15. Comparison of Conventional and Normalized Calibration Strategies: Case With Learning and No Undersizing

normalization process, was *less* in this scenario (no undersizing) than in the base case (with undersizing). This is reflected in Figure 18, where a plot of the average improvement in productivities as a result of normalization shows minimal variance between the two scenarios.

Composite cycle productivities within the domain of the "no undersizing" scenario, again showed a significant improvement over the span of the six project cycles, with the conventional strategy yielding an improvement of 32.3 percent, and the normalization strategy 43.7 percent. These productivity improvements (without undersizing), however, are only marginally better than those realized in the base case (with undersizing). Figure 19 presents a graphical summary of composite cycle productivity, comparing raw and normalized results in both the undersizing and no-undersizing scenario. It is evident that by the third project cycle, composite productivity under the normalized calibration strategy surpasses the productivity values achieved under the conventional calibration strategy, regardless of whether or not the project's size was underestimated. This finding suggests that normalization may be an effective tool that can help offset the negative effects of project estimation undersizing. Nevertheless, further research is required to support this claim.

Estimated productivity comparisons under this scenario reveal some interesting results. With no undersizing, actual and estimated individual project productivities are nearly identical in cycle one (Figure 20). These values are the same in the conventional and normalized cases, since the initial effect of the normalization process is not evident

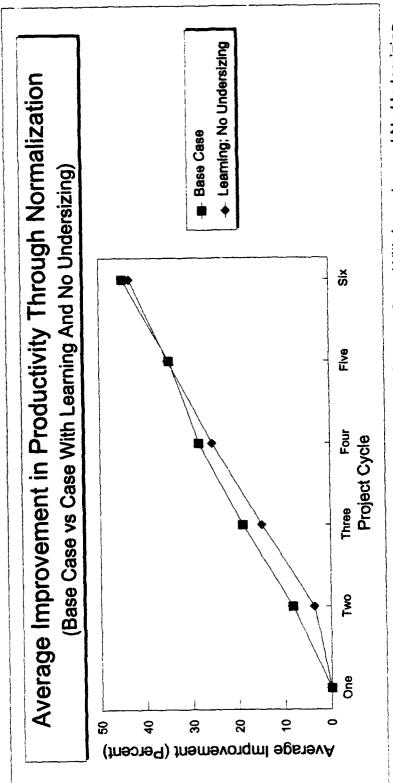


Figure 18. Average Improvement In Productivity: Base Case vs Case With Learning and No Undersizing.

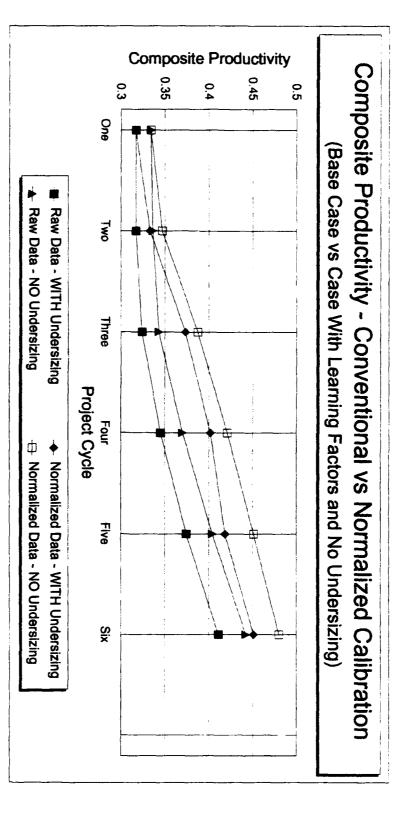


Figure 19. Composite Productivity: Conventional vs Normalized - Base Case vs Case With Learning and No Undersizing

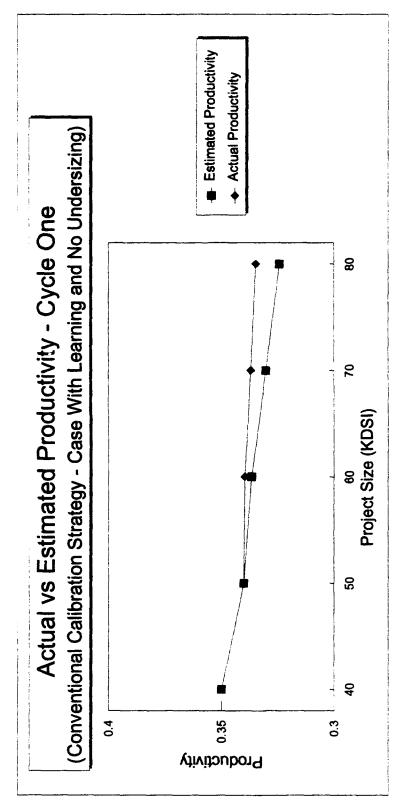


Figure 20. Actual vs Estimated Productivity: Cycle One - Conventional Strategy - Case With Learning and No Undersizing

until project cycle two. However, using the conventional strategy (raw data), estimates of productivity begin to drift, and by cycle six lag actual productivities by a range of 6.8 percent to 10.86 percent (Figure 21). Conversely, normalized data continues to produce precise estimates within one percent of actual productivity values in cycle six (Figure 22). This would indicate a more responsive calibration of the COCOMO constant by the normalization process in this scenario.

The relative error in the accuracy of COCOMO's project cost estimation under conventional and normalized calibration strategies is quite dramatic in this scenario of no undersizing, as can be clearly seen in Figure 23. With "perfect" size input, normalization of the data results in consistent COCOMO cost estimates across all project cycles, with a relative error rate of less than one-half percent. Conversely, while conventionally-calibrated COCOMO produces "tight" cost estimates in project cycles one and two, the error rate balloons to nearly ten percent by cycle six.

#### D. EFFECTS OF NO LEARNING ON BASE CASE RESULTS

In this experiment, the project set was re-simulated in a scenario which included undersizing, but assumed no learning between project cycles. The methodology differed from the base case only in the fact that the SD simulator parameter DSIPTK remained fixed at the default value of "60" for all project simulations. This effectively eliminated the learning assumption, by modeling the experiment with a "flat" delivered-source-instruction-per-task rate from cycle to cycle. Appendices G, H, and I document the results of the experiment.

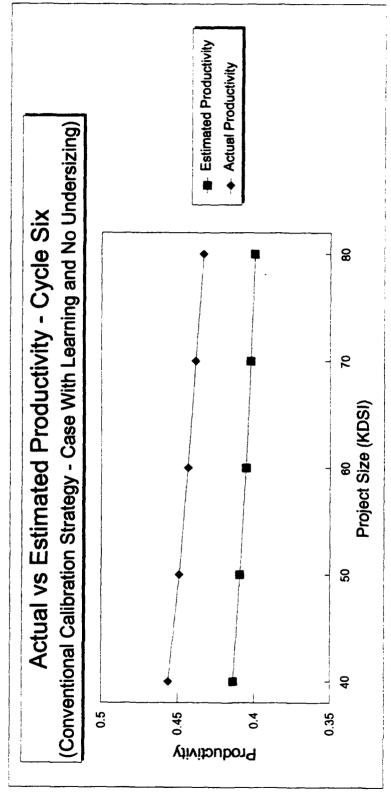
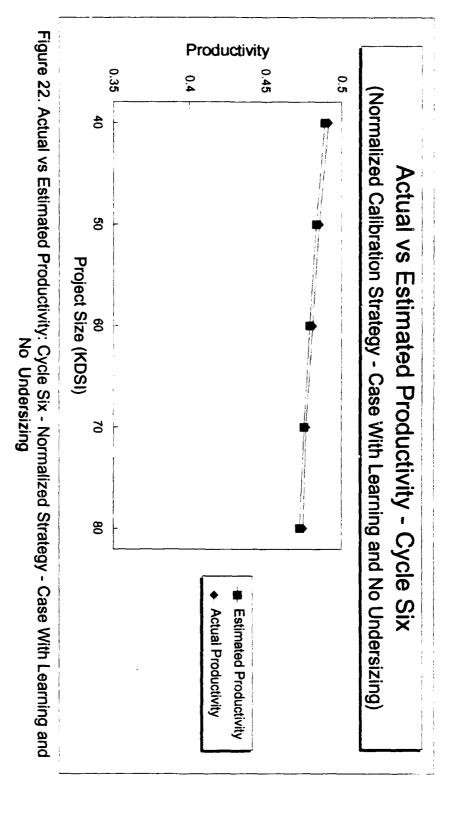


Figure 21. Actual vs Estimated Productivity: Cycle Six - Conventional Strategy - Case With Learning and No Undersizing



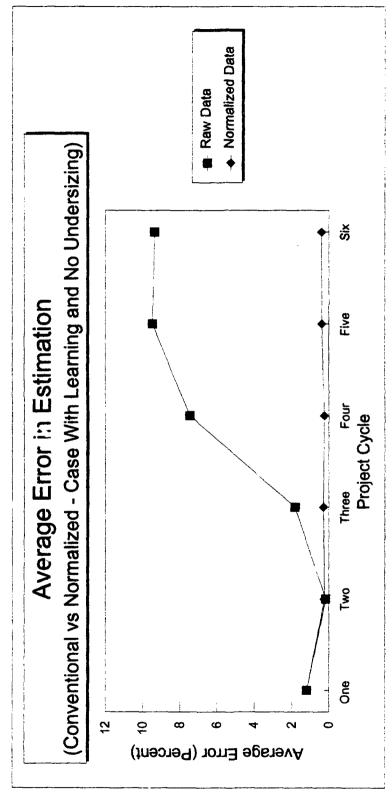


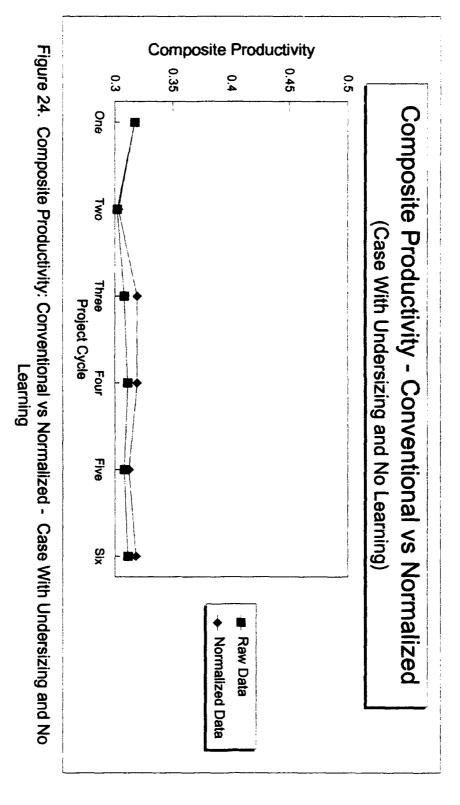
Figure 23. Average Error in Accuracy of Estimation of Project Cost: Case With Learning and No Undersizing

Results of the experiment are summarized in Table 16, and show that while individual project productivity using the conventional calibration strategy varied between .26 and .35, composite productivity through the six project cycles *decreased* marginally from .317 to .311 (1.89 percent). In this scenario (undersizing but no learning), the normalization strategy yielded minimal improvement, at best, over the conventional strategy in terms of real effort (-2.92 percent to 6.54 percent), individual project productivity (-3.85 percent to 6.25 percent) and composite productivity (.33 percent to 3.57 percent). In addition, with normalization, composite productivity over the six project cycles improved only trivially from .317 to .318 (.315 percent). These composite productivity values are graphically represented in Figure 24, and provide an important observation. The findings suggest that, in an environment devoid of learning, both the conventional *and* normalization calibration strategies are largely ineffective in improving productivity.

Similarly, both estimated productivity and relative accuracy values are inconclusive in this scenario. In the case of the conventional strategy, raw data values produce underestimates of productivity averaging 4.5 percent, while the normalization strategy yields overestimates averaging 8.9 percent. The accuracy of project cost estimation favors the conventional COCOMO calibration strategy in three of the five project serials, besting the normalized model's average relative error rate, 6.08 percent to 7.62 percent.

	Cycle {	Cycle & Project		Raw Data	-	S	Normalized Data	ata	Perc	Percent Improvement	ement
1 120.9 0.33 2 149.7 0.33 3 187.6 0.32 2 245.3 0.33 1 116.7 0.36 1 116.7 0.36 4 227.4 0.31 1 124.8 0.32 2 150.4 0.31 1 119.1 0.34 1 119.1 0.34 1 119.1 0.34 2 257.4 0.33 1 188.6 0.3 2 165.4 0.3 2 266.2 0.28 2 266.2 0.3 3 181.5 0.33 1 121.3 0.33 1 121.3 0.33 1 121.3 0.33 1 121.3 0.33 1 121.3 0.33 1 121.3 0.33	Cycle #	Project #	MM (act)	Productivity	Comp.Prod	MM (act)	<b>Productivity</b>	Productivity Comp. Prod	MM (act)	<b>Productivity</b>	Productivity Comp. Prod
2     149.7     0.33       3     187.6     0.32       4     245.8     0.28       5     160.3     0.31       1     116.7     0.35       3     164.6     0.35       4     227.4     0.31       4     227.4     0.32       5     198.6     0.3       6     273.1     0.32       7     116.6     0.32       8     165.0     0.3       9     165.0     0.3       1     115.1     0.33       1     117.6     0.33       2     163.4     0.33       3     203.6     0.29       1     17.6     0.33       1     17.6     0.33       1     17.6     0.33       2     160.4     0.33       1     17.6     0.33       2     160.4     0.33       3     191     0.31       4     252.9     0.28	-	-	120.9	0.33		120.9	0.33		%00.0	%00.0	
3     187.6     0.32       4     246.8     0.28       2     242.3     0.33       1     116.7     0.35       3     184.6     0.33       4     227.4     0.31       4     227.3     0.32       1     124.8     0.32       5     267.4     0.32       6     273.1     0.29       7     149.1     0.34       8     267.4     0.33       9     181.5     0.33       1     17.6     0.33       2     163.4     0.33       3     203.5     0.29       4     213.3     0.33       1     17.6     0.34       1     17.6     0.33       2     153.4     0.33       3     203.5     0.28       3     181     0.33       4     252.9     0.28	-	2	149.7	0.33		149.7	0.33		%00.0	%00.0	
4     246.8     0.28       5     242.3     0.33       1     116.7     0.35       3     184.6     0.33       4     227.4     0.34       4     227.7     0.32       1     124.8     0.32       5     198.6     0.32       6     273.1     0.29       7     149.1     0.34       8     286.2     0.28       9     165.4     0.33       1     117.6     0.33       2     163.4     0.33       3     203.6     0.29       4     213.3     0.33       1     17.6     0.34       1     17.6     0.33       2     153.4     0.33       3     203.5     0.28       4     252.9     0.28	-	က	187.6	0.32		187.6	0.32		%00.0	%00.0	
5     242.3     0.33       2     160.3     0.31       1     116.7     0.35       3     164.6     0.33       4     227.4     0.31       4     227.4     0.31       2     124.8     0.32       4     227.4     0.32       5     273.1     0.29       6     273.1     0.29       7     119.1     0.34       8     20.3     0.33       9     20.3     0.33       1     117.6     0.34       1     117.6     0.33       1     117.6     0.33       1     126.3     0.33       1     126.3     0.33       1     126.3     0.33       1     126.3     0.33       1     126.3     0.33       1     126.9     0.30       2     150.4     0.33       3     191     0.31       4     252.9     0.26	-	4	245.8	0.28		245.8	0.28		%00.0	%00.0	
2 160.3 0.31 1 116.7 0.35 3 164.6 0.33 4 227.4 0.31 4 227.7 0.35 3 198.6 0.32 1 124.8 0.32 5 273.1 0.29 1 119.1 0.34 5 286.2 0.28 2 163.4 0.33 2 203.5 0.33 1 17.6 0.34 1 117.6 0.33 2 153.4 0.33 3 203.5 0.33 1 17.6 0.33 1 121.3 0.33 1 121.3 0.33	-	2	242.3	0.33	0.317	242.3	0.33	0.317	%00.0	%00.0	0.00%
1 116.7 0.35 3 164.6 0.33 4 227.4 0.31 4 227.4 0.31 1 124.8 0.32 2 156 0.32 5 273.1 0.29 4 242.2 0.29 1 149.1 0.34 1 149.1 0.34 2 165.4 0.31 2 203.5 0.33 3 203.5 0.33 1 17.6 0.34 1 17.6 0.33 1 121.3 0.33 1 121.3 0.33	7	2	160.3	0.31		155.3	0.32		3.12%	3.23%	
3 164.6 0.33 4 227.4 0.31 4 227.4 0.31 1 124.8 0.32 2 156 0.32 4 242.2 0.29 4 242.2 0.29 1 119.1 0.34 1 119.1 0.34 2 165 0.3 2 267.4 0.31 2 181.5 0.33 2 203.5 0.28 2 150.4 0.33 1 17.6 0.34 1 17.6 0.34 1 121.3 0.33 191 0.31	2	-	116.7	0.35		115.1	0.35		0.52%	%00:0	
5     305.1     0.26       4     227.4     0.31       3     198.6     0.32       1     124.8     0.32       5     273.1     0.29       4     242.2     0.29       1     119.1     0.34       5     257.4     0.31       5     226.2     0.33       6     214     0.33       7     153.4     0.33       1     17.6     0.34       1     17.6     0.33       2     153.4     0.33       3     203.6     0.29       4     252.9     0.33       1     17.6     0.31       9     181     0.33	2	3	184.6	0.33		181.5	0.33		1.68%	0.00%	
4     227.4     0.31       4     221.3     0.32       1     124.8     0.32       2     156     0.32       4     242.2     0.29       4     247.1     0.29       5     257.4     0.31       6     257.4     0.31       7     119.1     0.33       8     246.2     0.33       9     161.5     0.33       1     17.6     0.33       1     17.6     0.33       2     153.4     0.33       1     17.6     0.34       1     17.6     0.33       2     150.4     0.33       3     191     0.33       4     252.9     0.26	2	2	305.1	0.26		314	0.25		-2.92%	-3.85%	
4     221.3     0.32       3     1986     0.3       1     124.8     0.32       2     156     0.32       4     242.2     0.29       1     149.1     0.34       5     257.4     0.31       2     165     0.3       3     181.5     0.33       4     214     0.33       4     214     0.33       1     17.6     0.33       2     150.4     0.33       1     17.6     0.33       2     150.4     0.33       3     191     0.31       3     191     0.31       4     252.9     0.28	7	4	227.4	0.31	0.302	224.6	0.31	0.303	1.23%	0.00%	0.33%
3     198.6     0.3       1     124.8     0.32       2     156     0.32       4     242.2     0.29       1     119.1     0.34       2     257.4     0.31       3     181.5     0.33       4     214     0.33       5     286.2     0.29       4     214     0.33       2     153.4     0.33       1     177.6     0.33       2     150.4     0.33       3     150.4     0.33       4     252.9     0.28	က	4	221.3	0.32		216.1	0.32		2.35%	%00.0	
1 124.8 0.32 2 156 0.32 4 242.2 0.29 1 119.1 0.34 1 119.1 0.34 2 257.4 0.31 3 181.5 0.33 4 214 0.33 1 17.6 0.34 1 117.6 0.33 1 121.3 0.33 2 150.4 0.33 1 121.3 0.33	က	8	198.6	0.3		192.6	0.31		3.02%	3.33%	
2 156 0.32 4 242.2 0.29 4 242.2 0.29 1 119.1 0.34 5 257.4 0.31 5 286.2 0.28 4 214 0.33 2 153.4 0.33 1 17.6 0.34 1 117.6 0.34 1 121.3 0.33 2 150.4 0.33 3 203.5 0.38	က	-	124.8	0.32		122.8	0.33		1.60%	3.13%	
5     273.1     0.29       4     242.2     0.29       1     119.1     0.34       2     257.4     0.31       3     181.5     0.33       4     214     0.33       2     153.4     0.33       3     203.5     0.29       1     17.6     0.34       1     121.3     0.33       2     150.4     0.33       3     191     0.31       4     252.9     0.28	က	2	156	0.32		145.8	0.34 4.0		6.54%	6.25%	
4     242.2     0.29       1     119.1     0.34       5     257.4     0.31       2     165     0.3       5     286.2     0.28       4     214     0.33       2     153.4     0.33       1     17.6     0.34       1     121.3     0.33       2     150.4     0.33       3     191     0.31       4     252.9     0.28	m	5	273.1	0.29	0.308	262.5	0.3	0.319	3.88%	3.45%	3.57%
1 119.1 0.34 5 257.4 0.31 2 165 0.3 3 181.5 0.33 4 214 0.33 2 153.4 0.33 1 17.6 0.34 1 17.6 0.34 1 121.3 0.33 2 150.4 0.33 3 191 0.31	4	4	242.2	0.29		233.8	0.3		3.47%	3.45%	
5 257.4 0.31 2 165 0.3 3 181.5 0.33 5 286.2 0.28 2 286.2 0.28 2 153.4 0.33 1 17.6 0.34 1 121.3 0.33 2 150.4 0.33 4 252.9 0.28	4		119.1	0.34		119.7	0.33		-0.50%	-2.94%	
2 165 0.3 3 161.5 0.33 5 286.2 0.28 4 214 0.33 2 153.4 0.33 1 17.6 0.34 1 121.3 0.33 2 150.4 0.33 4 252.9 0.28	4	2	257.4	0.31		250.6	0.32		2.64%	3.23%	
3 181.5 0.33 5 286.2 0.28 4 214 0.33 2 153.4 0.33 3 203.6 0.29 1 117.6 0.34 1 121.3 0.33 2 150.4 0.33 4 252.9 0.28	4	2	165	0.3		159.5	0.31		3.33%	3.33%	
5 286.2 0.28 4 214 0.33 2 153.4 0.33 3 203.6 0.29 1 117.6 0.34 1 121.3 0.33 2 150.4 0.33 4 252.9 0.28	4	ಕ	181.5	0.33	0.311	176.9	0.34	0.319	2.53%	3.03%	2.57%
4     214     0.33       2     153.4     0.33       3     203.6     0.29       1     117.6     0.34       2     150.4     0.33       3     191     0.31       4     252.9     0.28	S.	2	286.2	0.28		284.6	0.28		0.56%	%00.0	
2 153.4 0.33 3 203.6 0.29 1 117.6 0.34 1 121.3 0.33 2 150.4 0.33 3 191 0.31 4 252.9 0.28	2	4	214	0.33		208.7	0.3 <b>4</b>		2.48%	3.03%	
3 203.6 0.29 1 117.6 0.34 1 121.3 0.33 2 150.4 0.33 3 191 0.31 4 252.9 0.28	2	2	153,4	0.33		152	0.33		0.91%	%00:0	
1 117.6 0.34 1 121.3 0.33 2 150.4 0.33 3 191 0.31 4 252.9 0.28	2	ဗ	203.5	0.29		198.6	0.3		2.41%	3.45%	
1 121.3 0.33 2 150.4 0.33 3 191 0.31 4 252.9 0.28	2	-	117.6	0.34	0.308	118	0.3 <b>4</b>	0.312	-0.34%	%00.0	1.30%
2 150,4 0.33 3 191 0.31 4 252.9 0.28	9	-	121.3	0.33		120.7	0.33		0.49%	0.00%	
3 191 0.31 4 252.9 0.28	9	7	150.4	0.33		148.5	0.34		1.26%	3.03%	
4 252.9 0.28	စ	က	191	0.31		187.3	0.32		1.94%	3.23%	
	စ	4	252.9	0.28		245.9	0.28		2.77%	%00.0	
5 250.1 0.32	9	2	250.1	0.32	0.311	241.5	0.33	0.318	3.44%	3.13%	2.25%

Table 16. Comparison of Conventional and Normalized Calibration Strategies: Case With Undersizing and No Learning



### E. THE EFFECTS OF OVERESTIMATION AND UNDERESTIMATION OF PRODUCTIVITY ON SIMULATION RESULTS

The final series of experiments examines the impact of overestimation / underestimation of productivity on project set results. In this scenario, we again assume undersizing and no learning, as in the previous experiment. However, this experiment explores the effect of misrepresenting productivity by virtue of how a "task" is defined.

Central to the notion of variable task definition is the situation where different software development organizations require different development efforts to design and code projects of a similar size and scope. Consequently, where DSI is constant and fixed in both organizations, the value of "task" becomes the determinant with regard to measuring effort.

First, the project set is re-simulated with underestimation and no learning, but with a DSIPTK value fixed at 75 percent of the nominal case. The nominal case default value of the SD simulator is "60", hence, the input metric is set at "45". Cost and productivity values are calculated in the usual manner, using both the conventional and normalization calibration strategies. Data and calculations are presented in Appendices J, K, and L, and are summarized in Table 17. A comparison with Table 16 values (undersizing, no learning, nominal DSIPTK value), and employing the conventional strategy with raw historical data, reveals significantly lower individual project productivities in each instance. Likewise, composite cycle productivities fall by 15.5 percent to 17.8 percent. The effects of normalization under these experimental conditions are negligible. Both individual

0.00%	0.00%	0.27%	0.261	0.27	301.7	0.261	0.27	300.9	S1	6
	4.35%	1.24%		0.24	294.7		0.23	298.4	4	æ
	0.00%	0.08%		0.26	227.8		0.26	227.6	သ	6
	0.00%	0.11%		0.28	178,5		0.28	178.7	2	6
	0.00%	-0.34%		0.27	146.2		0.27	145.7	-	6
2.37%	7.41%	6.24%	0.259	0.29	139.8	0.263	0.27	149.1	1	<b>5</b> 1
	0.00%	0.78%		0.25	241.6		0.25	243.4	IJ	S.
	0.00%	0.81%		0.27	183.1		0.27	184.6	2	Oi
	3.86%	2.88%		0.27	256.7		0.26	264.3	•	C)
	4.35%	1.02%		0.24	339.2		0.23	342.7	Ġ	C)1
-0.38%	0.00%	0.69%	0.261	0.28	214.5	0.262	0.28	216	w	•
	0.00%	-1.04%		0.26	194.2		0.26	192.2	2	4
	0.00%	0.74%		0.26	312		0.26	309.7	Ċ1	4
	G.00%	0.42%		0.28	142.4		0.28	143	-	4
	0.00%	0.14%		0.26	286.2		0.25	284.8	٨	4
0.38%	0.00%	0.43%	0.261	0.25	324.0	0.26	0.25	323.5	O1	3
	7.41%	4.26%		0.29	175.3		0.27	163.1	2	w
	0.00%	-1.28%		0.27	156		0.27	148.1	1	w
	0.00%	-0.17%		0.25	235.8		0.25	236.4	ယ	ω
	0.00%	0.34%		0.26	264.9		0.26	265.8	•	w
0.00%	-3.85%	7.44%	0.252	0.25	252.4	0.252	0.26	272.7	•	~
	0.00%	-0.08%		0.22	370.7		0.22	370.4	o,	2
	0.00%	0.32%		0.27	220		0.27	220.7	ယ	2
	0.00%	0.36%		0.29	137.6		0.29	136.1		2
	-3.70%	-0.16%		0.26	187.7		0.27	187.4	2	2
0.00%	0.00%	0.00%	0.262	0.28	138.1	0.262	0.28	138.1	O.	-
	0.00%	0.00%		0.23	187.4		0.23	187.4	4	-
	0.00%	0.00%		0.27	289.8		0.27	289.8	ယ	
	0.00%	0.00%		0.28	307.8		0.28	307.8	N	-
	0.00%	6		0.28	221.8		0.28	221.8		1
Comp.Pro	Productivity Comp.Prod	MM (act)	Comp.Prod	Productivity Comp. Prod	MM (ect)	Comp.Prod	Productivity Comp. Prod	MM (act)	Project #	Cycle #
ment	Percent Improvement	Percer	X = 15%	Normalized: USIPIK = /5%	Normaliz	(E/5%	Raw Data: DSIP IK = 75%	Kaw Da	Cycle & Project	Cycle &
1			2							

Table 17. Comparison of Conventional and Normalized Calibration Strategies: Case With Undersizing, No Learning and DSIPTK = 75% of Nominal Case

project productivities and composite cycle productivities are virtually unchanged despite normalization (improvement range of -.38 percent to 2.37 percent).

Next, the DSIPTK value was set at 125 percent of the nominal case, or "75", and the projects re-simulated yet again with all other conditions unchanged. Supporting data and calculations are presented in Appendices M, N, and O, and are summarized in Table 18. Results under the conventional strategy reveal a global improvement in individual project productivity. Similarly, composite cycle productivity improves by an average of 10.34 percent over Table 16 (nominal) values. The effect of normalization in this scenario, while not as dramatic as under the learning assumption (Table 13), nevertheless improves composite productivity by an average of 11.96 percent over the Table 16 values, and yields an improvement over conventional strategy values ranging from 2.09 to 4.85 percent.

Figure 25 is a graphical representation of composite productivity under all exercise conditions described in this section, and includes data carried forward from the previous section (DSIPTK = 100%) for comparison purposes. The composite productivity positioning is readily apparent and appears directly linked to DSIPTK values/percentages. The figure also provides a view of the effects of normalization on each of the three data sets. Clearly, the higher DSIPTK values yield the more significant normalization benefit.

Cycle &	Cycle & Project	Raw Da	Raw Data: DSIPTK = 125%	= 125%	Normaliz	Normalized: DSIPTK = 125%	<= 125%	Perc	Percent Improvement	ment
Cycle #	Project #	MM (act)	Productivity Comp.Prod	Comp.Prod	MM (act)	Productivity	Productivity Comp.Prod	MM (act)	Productivity Comp.Prod	Comp.Pr
	-	109.5	0.37		109.5	0.37		0.00%	0.00%	
<b>-</b>	2	138.2	0.36		138.2	0.36		0.00%	0.00%	
	w	169	0.36		169	0.36		0.00%	0.00%	1
-	4	230.9	0.3		230.9	0.3		0.00%	0.00%	
	J)	224.1	0.36	0.344	224.1	0.36	0.344	0.00%	0.00%	0.00%
2	2	140.2	0.36		140.1	0.36		0.07%	0.00%	
2	_	108.5	0.37		1 00.1	0.4		7.74%	8.11%	
2	ω	164.2	0.37		64.1	0.37		0.06%	0.00%	
2	<b>C</b> JI	280.7	0.29		273	0.29		2.74%	0.00%	
2	4	202.4	0.35	0.335	199.3	0.35	0.342	1.53%	0.00%	2.09%
ω	4	201	0.35		191.9	0.36		4.53%	2.86%	į
ယ	ω	175.8	0.34		172.5	0.35		1.88%	2.94%	
ω		112.7	0.35		108	0.37		3.28%	5.71%	
3	2	142.5	0.35		128.7	0.39		9.68%	11.43%	
ယ	CTI	240	0.33	0.344	234.3	0.34	0.359	2.37%	3.03%	4.36%
4	4	218	0.32		205.8	0.34		5.60%	6.25%	
-	-	104.6	0.38		105.2	0.38		-0.57%	0.00%	
4	Cī	228.4	0.35		219.4	0.36		3.94%	2.86%	
4	2	146.7	0.34		138.7	0.36		5.45%	5.88%	
4	ω	167.6	0.38	0.351	154.8	0.39	0.364	1.78%	2.63%	3.70%
Ch	Cī	256.7	0.31		257.3	0.31		-0.23%	0.00%	
ဟ	4	206.3	0.34		186.7	0.37		9.50%	8.82%	
5	2	145.6	0.34		134.8	0.37		7.42%	8.82%	
G	သ	183.9	0.33		184.5	0.33		-0.33%	0.00%	
(J)	1	115.8	0.35	0.33	102.8	0.39	0.346	11.23%	11.43%	4.85%
G	1	109.3	0.37		106.8	0.37		2.29%	0.00%	
6	2	137.7	0.36		133.6	0.37		2.98%	2.78%	
6	3	168.8	0.36		165.6	0.36		1.90%	0.00%	
O	4	231.3	0.3		217.7	0.32		5.88%	6.67%	
0	CT	223	0.36	0.345	212.2	0.38	695.7	4.84%	5.56%	4.06%

Table 18. Comparison of Conventional and Normalized Calibration Strategies: Case With Undersizing, No Learning and DSIPTK = 125% of Nominal Case

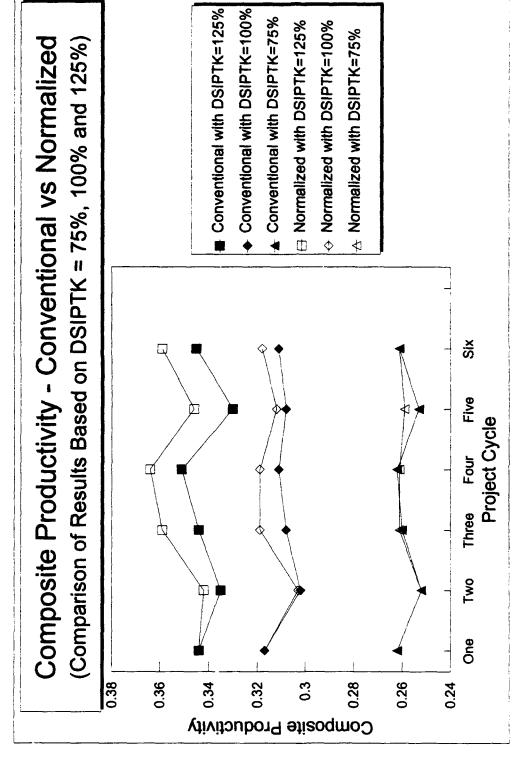


Figure 25. Composite Productivity: Conventional vs Normalized DSIPTK = 75%, 100%, and 125%

#### V. CONCLUSIONS

#### A. SUMMARY OF FINDINGS AND IMPLICATIONS

The major objective of this thesis was to use simulation modeling to replicate the development of a set of 30 hypothetical software projects, the results of which were used to evaluate two competing calibration strategies for the COCOMO software estimation tool in four experimental scenarios.

#### 1. Phase One

In phase one, the simulated project costs obtained by applying the conventional calibration strategy, were evaluated against a similar set of cost values obtained by applying the normalized calibration strategy in a scenario which assumed both learning and undersizing. The normalization process contributed to significant increases in both individual project productivity and composite cycle productivity. The experiment demonstrated that normalization provided the organization with more optimal calibration coefficients which, in turn, lead to more optimal cost estimations. As inefficiencies were eliminated in project cost estimation, simulations produced projects with lower actual costs, and hence, improved productivity.

The experiment also demonstrated that the normalization strategy provided the software organization with the *potential* for significant future cost savings. The normalization process effectively removed many of the inefficiencies associated with undersized projects. Consequently, archiving normalized cost data in the organizational data base vice the actual project results, produced more optimal estimates when identical projects were re-simulated following model calibration. In contrast, as a result of higher calibration coefficients, the conventional calibration strategy produced consistently larger and less optimal cost estimates.

Post-facto knowledge of the projects' actual size was used to calculate two related exercise metrics, both of which provided an indication of the relative accuracy and validity of the software estimation tool — estimated productivity and relative error in cost estimation. The normalized cost data produced the strongest correlation between actual and estimated productivity results, indicating that the model provided more accurate estimates. This was confirmed when the computed accuracy of the base case COCOMO estimates clearly favored the normalized calibration model.

#### 2. Phase Two

In phase two, the base case results of phase one were compared with simulated results of a new case assuming learning, but no undersizing. With no undersizing, both the conventional and normalized calibration strategies produced global improvements in project productivities over base case results. Normalization again provided cost benefit over raw historical data, but in this scenario, the average improvement in individual project productivity was less dramatic than in the base case. Similarly, composite cycle productivities were only marginally improved over their base case counterparts. These findings suggest that normalization may be an effective strategy to counterbalance the detrimental effects of initial project undersizing. Both estimated productivity and

relative accuracy solutions in this scenario revealed that the conventional calibration strategy produced increasingly suboptimal model performance over the six project cycles. Conversely, the normalized model continued to provide extremely precise estimates throughout all project cycles.

#### 3. Phase Three

Phase three re-simulated the project set in a scenario which included project size underestimation, but no learning. Normalization was least effective in this scenario, yielding minimal improvement, at best, over the conventional strategy in all key cost and productivity metrics. The findings suggest that without learning, both the conventional and normalization calibration strategies are largely ineffective in improving productivity. A comparison of relative model accuracy was also inconclusive in this scenario.

#### 4. Phase Four

The final phase of the experiment investigated the impact of both underestimation and overestimation of productivity on the results of the phase three experiment. First, with productivity underestimated by a factor of 75 percent of the nominal case, all productivity metrics were degraded, and normalization had a negligible impact. Next, with productivity overestimated by a factor of 125 percent of the nominal case, all productivity values showed improvement. Normalization was again effective in this scenario, but less dramatically than in the base case (learning and no undersizing). Productivity in this scenario appears directly linked to the concept of variable task definition as it relates to the number of delivered source instructions per task (DSIPTK). In addition, the effects of

normalization also tend to follow this DSIPTK movement — the higher DSIPTK values yield the more significant normalization benefit.

#### **B. FURTHER RESEARCH RECOMMENDATIONS**

Three interesting research directions could be pursued as follow-on to this study. The first possibility is a validation of the findings of this simulation-based study by conducting an experiment in a real organization to compare the two strategies. Second, the current normalization strategy seeks to eliminate the inefficiencies caused by undersizing. The SD simulator could be used to examine the possibilities of eliminating other sources of inefficiency such as the misallocation of staff resources. Third, the normalization process requires repeated simulations to arrive at the optimal cost solution, and as such, is quite labor and time-intensive. The possibility for automating the process, perhaps employing artificial intelligence techniques, could be investigated.

### APPENDIX A. CONVENTIONAL CALIBRATION STRATEGY: BASE CASE

	<del></del>			CYCLE#1	(Raw Data)						<del></del>
0-10-1	DSPIK(S)	WAR COA	The 181	TOTAL COM	LE CONTRACTOR	TDEV (cal)		A Const	TORY (CEO		<del></del>
PTO SEE	100	40	40	24	57.5	12.4		120.9	18.5		<u> </u>
2	100	50	20	40	115.4	15.2		149.7	18.6		+
3	100	80	30	42	121.5	15.5		187.6	19.9		<del></del>
4	100	70	50	35	100.3	14.4		245.8	21.9		
5	100	80	10	72	214	19.2		2423	22.3		<del></del>
	100		19	12	613	194		-	- 44-3		<del></del>
0-1	(CC)	LEU Z	V V	0	W. Warden	sum MM(act) Q	0.5	707	7-22-31		Y Comp Prod
10.35	40	115.4	120.9	48	5403	5803	2304		Ya.	0.33	TO THE PERSON NAMED IN COLUMN
2	50	145.9	149.7	61	9132	14935	3721	6025		0.33	+
3	80	176.7	187.6	74	13882	29817	5476	11501	<del> </del>	0.32	
4	70	207.8	245.8	87	21385	50202	7589	19070	ļ	0.28	+
5	80	239	242.3	100	24230	74432	10000	29070	2.56	2.33	0.317
				199	676.00	1770	14444	27010		7.20	+ 42
<del></del>	<del></del>	<del></del>	<del> </del>	<del> </del>	<del> </del>	<del> </del>			<del></del>		<del></del>
	<del></del>		<del> </del>		<del> </del>	<del> </del>		<del> </del>	<del></del>		<del></del>
	·	<u> </u>	<del></del>		<b></b>	<del></del>					<del>+</del>
				CYCLE #2	(Raw Data)						<del>,                                     </del>
Davi Carial	DSIPTK (%)	KING 7-3	72	MARKET ()	144 /X	TDEV (est)		Mark (and)	TDEV (act)		<del></del>
7	120	50	40	30	91	13.9		147.3	17.8		+
<del>                                     </del>	120	40	10	36	110.2	14.9		117.7	16.6		<del></del>
3	120	60	20	48	149.1	16.7		178.6	18.6		<del></del>
5	120	80	50	40	123.1	15.6		291.4	21.1		<del></del>
	120	70	30	49	152.4	16.9		209.9	19.3	<del></del>	<del></del>
	120	70	<del></del>	70	132.7	10.5		200.0	18.3		+
Davi Carial	KDSI (ed)	MA (max)	MA // acts and	Q	EBU CAN	sum MM(act)*Q	0/2	(A2	Cartes	-	y Comp Prod
7	50	155.7	147.3	61	8985	8985	3721	3721	Water of the last	0.34	Y COME FICE
<del>                                     </del>	40	123.1	117.7	48	5650	14635	2304	6025		0.34	+
3	80	188.5	178.6	74	13216	27851	5476	11501	<del></del>	0.34	+
<del>- 5</del> -	80	255	291.4	100	29140	58991	10000	21501	<del> </del>	0.27	
1-4-	70	221.6	209.9	87	18261	75252	7569	29070	2.59	0.33	0.317
		221.0	200.0		10201	100.00	1000	20010	2.50	0.55	9.5(7
	<del></del>	<del></del>	<del> </del>		<del> </del>			<del></del>	<del></del>		
	<del></del>	<del></del>	<del> </del>	<del></del>	<del> </del>			<del> </del>	<del>                                     </del>		+
<del></del>		<del></del>		<u> </u>	<del></del>			L	<del>'</del>		+
!				CYCLE#3	(Raw Data)						+
Divi Carlel	DSPTK(%)	KDSI (and)	Dryler (%)	MIN (and)	Mark (cost)	TDEV (est)		ALL (act)	TDEV (ect)		+
1 1 1	140	70	20	56	177.4	17.9		216.5	19.5		<del></del>
3	140	60	40	36	111.5	15		189.2	18.2		<del> </del>
1	140	40	50	20	60.2	11.9		123.1	17.4		<del>- </del>
2	140	50	10	45	141	16.4		147	17.4		<del></del>
5	140	80	30	56	177.4	17.9		251.2	19.8		+
	177			<del> </del>	367.53				102		
Pro Sala	KDSI (act)	Man (and)	MM(actual)	0	Marie 1	sum MM(act) Q	Q*2	SUM OV	Confident	Prochards a	y Comp Prod
4	70	224.2	216.5	87	18836	18836	7589	7589		0.32	, , , , , , , ,
$\frac{7}{3}$	80	190.7	189.2	74	14001	32837	5476	13045	<del>                                     </del>	0.32	+
1	40	124.6	123.1	48	5909	38746	2304	15349		0.32	+
2	50	157.5	147	61	8967	47713	3721	19070	<del> </del>	0.34	+
5						1					0.324
	80	258	251.2	100	25120	72833	10000	29070	2.51	0.32	
	80	258	251.2	100	25120	72833	10000	29070	2.51	0.32	0.324
	80	258	251.2	100	25120	72833	10000	290/0	2.51	0.32	0.324
	80	258	251.2	100	25120	72833	10000	290/0	2.51	0.32	0.324
	80	258	251.2			72833	10000	290/0	2.51	0.32	0.524
	80	258	251.2		25120 (Raw Data)	72833	10000	29070	2.51	0.32	USE
Proj.Sarial	DSIPTK (%)			CYCLE #4	(Raw Data)	72833	10000			0.32	U.S.g.
Proj.Sartel				CYCLE #4	(Raw Data)		10000		2.51	0.32	U.S.g.
Proj.Sartel	DSPTK(%)	KOSI (act)	Under (%)	CYCLE #4 ROSI (cel) 42	(Raw Data)	TDEV (est)	10000	MM (GE)	TDEV (act)	0.32	0.55
1	DSIPTK (%) 180 160	KDSI (ect) 70 40	Under (%) 40 30	CYCLE #4 (COS) (cod) 42 28	(Raw Data) MM (ast) 127.1 83	10EV (act) 15.8 13.4	10000	MM (act) 212.1 111.1	1DEV (ext) 18.2 16	0.32	0.385
1 5	DSIPTK (%)	KOSI (66)	Under (%)	CYCLE #4 KDSJ (cel) 42 28 64	(Raw Data)   MM (ast)   127.1   63   197.8	15.8 13.4 18.6	10000	212.1 111.1 233.8	TDEV (act) 18.2 16 19.5	0.32	0.58
4 1 5 2	DSSPTK (%) 160 160 160 160	KDSI (act) 70 40 80 50	Under (%) 40 30 20 50	CYCLE #4  KDS! (cel)   42   28   64   25	(Raw Data)  MM (cst)  127.1  83  197.8  73.7	10EV (est) 15.8 13.4 18.6 12.8		212.1 111.1 233.8 146.9	1DEV (act) 18.2 16 19.5 17.2	0.82	0.555
1 5	DSIPTK (%) 180 160 160	KDSI (ect) 70 40 80	Under (%) 40 30 20	CYCLE #4 KDSJ (cel) 42 28 64	(Raw Data)   MM (ast)   127.1   63   197.8	15.8 13.4 18.6		212.1 111.1 233.8	TDEV (act) 18.2 16 19.5	0.32	
1 5 2 3	DSIPTIK (%) 160 160 160 160 160	KOSI (act) 70 40 60 50	Under (%) 40 30 20 50	CYCLE #4  KOS! (cel)  42  28  64  25  54	(Raw Data) MM (cat) 127.1 63 197.8 73.7 166.5	TDEV (ext) 15.8 13.4 18.6 12.8 17.4		212.1 111.1 233.8 148.9 185.7	1DEV (act) 18.2 16 19.5 17.2 17.9		
1 5 2 3	DSIPTK (%) 160 160 160 160 160 KOSI (ast)	KOSI (act) 70 40 60 50 60	Under (%) 40 30 20 50	CYCLE #4  KOS! (cel)  42  28  64  25  54	(Raw Data) MM (cat) 127.1 63 197.8 73.7 166.5	10EV (est) 15.8 13.4 18.6 12.8	> > > > > > > > > > > > > > > > > > >	242.1 111.1 233.8 148.9 165.7	1DEV (act) 18.2 16 19.5 17.2 17.9		V(Coste) Prod
1 5 2 3	DSIPTIK (%) 160 160 160 160 160	KOSI (act) 70 40 60 50	Under (%) 40 30 20 50	CYCLE #4  KOS! (cel)  42  28  64  25  54	(Raw Data)  MM (cat)  127.1  83  197.8  73.7  186.5	TDEV (cet) 15.8 13.4 18.6 12.8 17.4		212.1 111.1 233.8 148.9 185.7	1DEV (act) 18.2 16 19.5 17.2 17.9	Productive 0.28	
4 1 5 2 3 Prot Serial	DSSPTK (%) 180 180 160 160 160 160 KOSI (ast)	ROSI (ect) 70 40 50 50 60	Under (%) 40 30 30 50 10	CYCLE #4  KDS3 (cm) 42 28 04 25 54	(Raw Data)  MM (cst)  127.1  63  197.8  73.7  166.5	TDEV (ced) 15.8 13.4 18.6 12.8 17.4 18.63 2378	7866	242.1 111.1 233.8 146.9 165.7	1DEV (act) 18.2 16 19.5 17.2 17.9	0.38	
4 1 5 2 3 Proj. Sarial	DSSPTK (%) 160 160 160 160 160 170 180 180 180 180 180 180	ROSS (act) 70 40 60 50 60 217.3 120.7	Under (%) 40 30 20 50 10 MM/cctan) 212.1	CYCLE #4  KDSI (ent)   42   28   64   25   54   67	(Raw Outs) MM (cat) 127.1 63 197.8 73.7 166.5 MM (cat) 18483 5333	10EV (ext) 15.8 13.4 18.6 17.4 18.6 17.4	\$\frac{\fin}}}}}}}{\firac{\frac{\frac{\frac{\frac{\frac{\frac{\frac{\frac}}}}}}}{\frac{\frac{\frac{\frac{\frac{\frac{\frac{\frac}}}}}}{\firac{\frac{\frac{\frac{\frac{\frac{\frac{\frac{\frac{\frac{\frac{\frac{\frac{\frac{\frac{\frac{\frac{\frac}}}}}}{\frac{\frac{\frac{\frac{\frac{\frac{\frac{\frac{\frac{\frac}}}}}}{\frac{\	MM (act) 2/12.1 111.1 233.8 146.9 165.7	1DEV (act) 18.2 16 19.5 17.2 17.9	Productive 0.28	

				CYCLE #5	(Plane Date)						
T. C. T. T. H.	D. PIKES	10.100	107-60	10.15	1 141 (40)	TOEV (CO)			TREV CO		
5	180	<b></b>	40	- 48	138.9	16.2		ZAL	18.2		
4	180	70	10	65	182.1	18.1	-	180	18.6		
2	160	50	30	3.5	66.5	14.3		130.6	16.4		
3	180	60	50	30	\$3.6	13.4		165.3	17.2		
1	140	40	_20			13.4		100.5	15.5		
	7-1			8	Marie Co.		0.2	-	Coulding		
بحجيد	7	24.7	225.0	10		7.00	18.65		. Acres	0.35	11 20 21
<del></del>	76	200.4	180	- 7		1236	793	175	•	0.30	
<del></del>	96	123	150.5		- 75	- 42-17	3721	21280	<del></del> -	- 633	
-₹	<del>- 5</del> -	173	1863	74	1225	55440	3476	1276	•	0.38	
<del></del>		113	100.5	45	- 20	63273	2304	25070	2 10	0.4	0.374
				-				•			
				CYCLE	(Plane Chaile)			•			
		w. ro	U T T O		(Planer Challe)				110.4V (CEO		•
	200	(v. jes	40		Har Said	11.5		T 83	15.7		
	200 200	44) 50	40 20	10 mg	61.3 104.5	11.5		1172	15.7 15.9		
2 3	200 200 200	40 20 60	40	72 74 40 42	61.3 104.9 110.4	113 14.8 14.3		1172	15.7 15.9 16.6		
2 3 4	200 200 200 200	46 50 60 70	40 20 30 30	40 40 40 55	613 104.9 110.4	113 14.6 14.9 13.8		117.2 146.8 188.3	15.7 15.9 16.8 17.3		
2 3 4 5	200 200 200	40 20 60	40 20 30	72 74 40 42	61.3 104.9 110.4	113 14.8 14.3		1172	15.7 15.9 16.6		
7 2 3 4 5	200 200 200 200 200 200	45 55 60 76	40 20 50 50 50	40 40 40 55	91.3 164.5 110.4 91.1 194.4	11.5 14.6 14.5 15.5		117.2 146.8 146.3 146.7	15.7 18.9 16.8 17.3 16.2		
2 3 4 5	200 200 200 200	45 55 60 76	40 20 50 50 50	60 40 40 50 72	613 104.9 110.4	11.5 14.6 14.5 15.5		117.2 146.3 146.3 146.3 146.3	15.7 15.9 16.8 17.3		
2 3 4 5	200 200 200 200 200 200	45 55 60 70 80	40 20 30 50 50	60 40 40 50 72	61.3 104.9 114.4 51.1 194.4	113 14.6 14.9 13.9 14.5		117.2 146.8 146.3 146.7	15.7 18.9 16.8 17.3 16.2		
7 2 3 4 5	200 200 200 200 200 200 200 400 400 400	45 55 60 70 80	40 20 50 50 50 60	100 miles	104.9 110.4 91.1 184.4	113 14.6 14.5 15.8	7,57	117.2 146.3 146.3 146.3 191.7	15.7 18.9 16.8 17.3 16.2		

### APPENDIX B. NORMALIZATION DATA: BASE CASE

	YCLE #1. I	PPO IECT	44			YCLE #1.	PRO IECT	#2
	TUEV (GE)					TDEV (est)		MM (act)
40	18.5	120.9	120.6		50	18.6	149.7	140.4
40	18.5	115	115.3		50	18.6	145	146.2
40	18.5	110	114.6		50	18.6	140	145.9
40	18.5	105	113.4		50	18.6	135	143.8
	18.5	100	112.7		50	18.6	130	143.1
40	18.5 18.5	95 90	112.7		50 50	18.6	125 120	142.9
40	18.5	86	113.3		50	18.6 18.6	118	142.6
1 20	18.5	80	115.4		50	18.6	115	142.6
<u> </u>	10.5		115.4		30	10.0	110	144.0
	YCLE #1, I					YCLE #1, I		
W-21 (40)	TDEV (est)	187.6	187.3		70	TDEV (eqt) 21.9	245.8	MM (act) 243.7
1 80	19.9	180	180.1		70	21.9	235	234.1
<b>8</b>	19.9	170	176.9		70	21.9	220	219.6
80	19.9	180	174.4		70	21.9	210	212.3
80	19.9	155	173.2		70	21.9	200	207.9
60	19.9	150	173		70	21.9	190	206.3
60	19.9	145	21		70	21.9	185	
60	19.9	140	173.4		70	21.9	175	204.7
60	19.9	135	174.3		70	21.9	170	205.3
	YCLE #1, I		#5 MM (act)			YCLE #2,		
80	22.3	242.3	246.7		50	18.3	142.7	MM (act)
80	22.3	235	242		50	18.3	130	131.3
80	22.3	225	238.8	<del></del>	50	18.3	120	130.4
80	22.3	220	237.6	F	50	18.3	115	128.9
80	22.3	215	236.6		50	18.3	110	128.4
80	22.3	210	236.5		50	18.3	105	120.7
80	22.3	205	4		50	18.3	100	128.7
80	22.3	200	237.2		50	18.3	95	130
80	22.3	195	238.2					
-	YOLE #0	DD0 150T				YOU F #0	DDO IFOT	. 40
	YCLE #2, I		#1 MM (act)			YCLE #2, TDEV (est)		#3 MM (act)
40	16.3	107.6	107.2		60	18.6	165.9	165.5
40	16.3	100	102.5		60	18.6	150	159.5
40	16.3	90	102.2		60	18.6	135	155.9
40	16.3	85	101.2	<b></b>	60	18.6	130	
40	16.3	80			60	18.6	125	155.7
40	16.3	75	101.7		60	18.6	120	156.8
40	16.3	70	103.3		60	18.6	110	161.1
						<del></del>	<del></del>	<del></del>

С	YCLE #2, F	PROJECT	#5	C	YCLE #2, F	PROJECT	#4
KDSI (eet)	TDEV (set)	MM (est)	MM (act)	KDSI (est)	TDEV (est)	MM (est)	MM (act)
80	21.4	277.9	269.6	70	19.8	207.7	207.3
80	21.4	240	239.3	70	19.8	170	185.5
80	21.4	210	218.5	70	19.8	160	184.2
80	21.4	190	213.4	70	19.8	155	
80	21.4	185		70	19.8	150	184.5
80	21.4	180	213.3	70	19.8	140	186.8
80	21.4	175	213.8				
80	21.4	170	215.5	·			<del>•</del>
C	YCLE #3, F	PROJECT	*4		YCLE #3, F	PROJECT	#3
			MM (act)		TDEV (est)		MM (act)
70	TDEV (est)	182,1	181.5	60	18.9	164.8	164.2
70	19.2	150	169.8	60	18.9	130	144.6
70	19.2	145	169.2	1 60	18.9	125	143.5
70	19.2	140	169.3	60	18.9	120	140.0
70	19.2	137.5	100.5	80	18.9	115	143.7
70	19.2	135	169.3	60	18.9	110	144.5
70	19.2	130	170.5		<u> </u>		÷
-					·		
C	YCLE #3, I	PROJECT	#1		YCLE #3, F		
KDSI (est)	TDEV (est)	MM (est)	MM (act)	KDSI (est)	TDEV (est)	MM (and)	MM (act)
KDSI (est) 40	TDEV (est) 18.3	MM (est) 104.6	MM (act) 104.3	KDSI (est) 50	10EV (est)	122.7	MM (act) 122.5
KDSI (est) 40 40	TDEV (est) 18.3 18.3	MM (est) 104.6 80	MM (act) 104.3 93.5	KDSI (est) 50 50	TDEV (est) 16.9 16.9	MM (aut) 122.7 100	MM (act)
KDSI (est) 40 40 40	TDEV (est) 18.3 18.3 18.3	MM (est) 104.6 80 77.5	MM (act) 104.3 93.5 93.6	KDSI (est) 50 50 50	TDEV (est) 16.9 16.9 16.9	MM (aut) 122.7 100 95	122.5 117.8
KDSI (est) 40 40 40 40 40	TDEV (est) 18.3 18.3 18.3 18.3	MM (est) 104.6 80 77.5 75	MM (act) 104.3 93.5 93.6	KDSI (est) 50 50 50 50 50	16.9 16.9 16.9 16.9	122.7 100 96 90	122.5 117.8
KDSI (est) 40 40 40 40 40	TDEV (est) 18.3 18.3 18.3 18.3 18.3	MM (est) 104.6 80 77.5 75 72.5	MM (act) 104.3 93.5 93.6	KDSI (est) 50 50 50	TDEV (est) 16.9 16.9 16.9	MM (aut) 122.7 100 95	122.5 117.8
KDSI (est) 40 40 40 40 40 40	TDEV (est) 18.3 18.3 18.3 18.3 18.3 18.3 18.3	MM (est) 104.6 80 77.5 75 72.5 70	MM (act) 104.3 93.5 93.6 94.2 95.1	KDSI (est) 50 50 50 50 50	16.9 16.9 16.9 16.9	122.7 100 96 90	122.5 117.8
KDSI (est) 40 40 40 40 40	TDEV (est) 18.3 18.3 18.3 18.3 18.3	MM (est) 104.6 80 77.5 75 72.5	MM (act) 104.3 93.5 93.6	KDSI (est) 50 50 50 50 50	16.9 16.9 16.9 16.9	122.7 100 96 90	122.5 117.8
KDSI (est) 40 40 40 40 40 40	TDEV (est) 18.3 18.3 18.3 18.3 18.3 18.3 18.3	MM (est) 104.6 80 77.5 75 72.5 70	MM (act) 104.3 93.5 93.6 94.2 95.1	KDSI (est) 50 50 50 50 50	16.9 16.9 16.9 16.9	122.7 100 96 90	122.5 117.8
KDSI (est) 40 40 40 40 40 40	TDEV (est) 18.3 18.3 18.3 18.3 18.3 18.3 18.3	MM (est) 104.6 80 77.5 75 72.5 70	MM (act) 104.3 93.5 93.6 94.2 95.1	KDSI (est) 50 50 50 50 50	16.9 16.9 16.9 16.9	122.7 100 96 90	122.5 117.8
KDSI (est) 40 40 40 40 40 40 40	TDEV (est) 18.3 18.3 18.3 18.3 18.3 18.3 18.3	MM (est) 104.6 80 77.5 75 72.5 70 80	MM (act) 104.3 93.5 93.6 94.2 95.1 98.4	KDSI (est) 50 50 50 50	16.9 16.9 16.9 16.9	MM (set) 122.7 100 96 90 60	122.5 117.8 117.9 129.8
KDSI (est) 40 40 40 40 40 40 40 C	TDEV (est) 18.3 18.3 18.3 18.3 18.3 18.3	MM (est) 104.6 80 77.5 76 72.5 70 60	MM (act) 104.3 93.5 93.6 94.2 95.1 98.4	KDSI (est) 50 50 50 50 60 CC KDSI (est)	10EV (est) 16.9 16.9 16.9 16.9 YCLE #4, F	MM (set) 122.7 100 95 90 60 PROJECT	122.5 117.8 117.9 129.8
KDSI (est) 40 40 40 40 40 40 40 C	TDEV (est) 18.3 18.3 18.3 18.3 18.3 18.3 18.3 18.3	MM (est) 104.6 80 77.5 75 70 60  PROJECT MM (est) 229.9	MM (act) 104.3 93.5 93.6 94.2 95.1 96.4 #5 MM (act) 228.8	KDSI (est) 50 50 50 50 50 CC KDSI (est)	10EV (est) 16.9 16.9 16.9 16.9 YCLE #4, F	MM (set) 122.7 100 96 90 60 PROJECT MM (est) 188	117.9 129.8 117.8 117.9 129.8
KDSI (est) 40 40 40 40 40 40 40 CC	TDEV (est) 18.3 18.3 18.3 18.3 18.3 18.3 18.3 YCLE #3, I	MM (est) 104.6 80 77.5 75 70 60  PROJECT MM (est) 229.9 200	MM (act) 104.3 93.5 93.6 94.2 95.1 96.4 #5	KDSI (est) 50 50 50 50 60 CC KDSI (est)	1DEV (est) 16.9 16.9 16.9 16.9 YCLE #4, F	MM (set) 122.7 100 95 90 60 PROJECT	#4 MM (act) 122.5 117.8 117.9 129.8
KDSI (est) 40 40 40 40 40 40 40 60 60 60 60 60 60 60 60 60 60 60 60 60	TDEV (est) 18.3 18.3 18.3 18.3 18.3 18.3 18.3 18.3	MM (est) 104.6 80 77.5 75 70 60  PROJECT MM (est) 229.9 200 180	MM (act) 104.3 93.5 93.6 94.2 95.1 96.4 #5 MM (act) 228.8 202.7 197.8	KDSI (est) 50 50 50 50 50 60 70 70	YCLE #4, FIDEV (est)  16.9  16.9  16.9  16.9  YCLE #4, FIDEV (est)  19.4  19.4	MM (set) 122.7 100 96 90 60 PROJECT MM (est) 188 160 140	MM (act) 122.5 117.8 117.9 129.8  #44  MM (act) 185.6 162.8 158.8
KDSI (est) 40 40 40 40 40 40 40 60 60 60 60 60 60 60 60 60 60 60 60 60	TDEV (est) 18.3 18.3 18.3 18.3 18.3 18.3 18.3 18.3	MM (est) 104.6 80 77.5 75 70 60  PROJECT MM (est) 229.9 200 180 170	MM (act) 104.3 93.5 93.6 94.2 95.1 96.4 #5 MM (act) 228.8 202.7	KDSI (est) 50 50 50 50 50 60 60 60 60 60 60 60 60 60 60 60 60 60	YCLE #4, FIDEV (est)  16.9  16.9  16.9  16.9  YCLE #4, FIDEV (est)  19.4  19.4  19.4	MM (set) 122.7 100 96 90 60 PROJECT MM (est) 188 160 140 135	#4 MM (act) 122.5 117.8 117.9 129.8 #4 MM (act) 185.6 162.8
KDSI (est) 40 40 40 40 40 40 40 60 60 60 60 60 60 60 60 60 60 60 60 60	TDEV (est) 18.3 18.3 18.3 18.3 18.3 18.3 18.3 18.3	MM (est) 104.6 80 77.5 75 70 60  PROJECT MM (est) 229.9 200 180 170 167.5	MM (act) 104.3 93.5 93.6 94.2 95.1 96.4  #5  MM (act) 228.8 202.7 197.8 195.6	KDSI (est) 50 50 50 50 50 50 70 70 70 70	YCLE #4, FIDEV (est)  16.9  16.9  16.9  16.9  YCLE #4, FIDEV (est)  19.4  19.4  19.4  19.4	MM (set) 122.7 100 96 90 60 PROJECT MM (est) 188 160 140 135 132.5	MM (act) 122.5 117.8 117.9 129.8 1185.6 162.8 158.8 157.9
KDSI (est) 40 40 40 40 40 40 40 60 60 60 60 60 60 60 60 60 60 60 60 60	TDEV (est) 18.3 18.3 18.3 18.3 18.3 18.3 18.3 18.3	MM (est) 104.6 80 77.5 75 72.5 70 80  PROJECT MM (est) 229.9 200 180 170 167.5 165	MM (act) 104.3 93.5 93.6 94.2 95.1 96.4 #5 MM (act) 228.8 202.7 197.8 195.6	KDSI (est) 50 50 50 50 50 50 70 70 70 70 70	YCLE #4, F TDEV (est) 16.9 16.9 16.9 YCLE #4, F TDEV (est) 19.4 19.4 19.4 19.4 19.4	PROJECT MM (est) 122.7 100 96 90 60	MM (act) 122.5 117.8 117.9 129.8 129.8 144 MM (act) 185.6 162.8 158.8 157.9
KDSI (est) 40 40 40 40 40 40 40 60 60 60 60 60 60 60 60 60 60 60 60 60	TDEV (est) 18.3 18.3 18.3 18.3 18.3 18.3 18.3 18.3	MM (est) 104.6 80 77.5 75 72.5 70 80  PROJECT MM (est) 229.9 200 180 170 167.5 165 162.5	#5 MM (act) 104.3 93.5 93.6  94.2 95.1 96.4  #5 MM (act) 228.8 202.7 197.8 195.6	KDSI (est) 50 50 50 50 50 50 70 70 70 70 70 70	YCLE #4, F TDEV (est) 16.9 16.9 16.9 YCLE #4, F TDEV (est) 19.4 19.4 19.4 19.4 19.4 19.4	PROJECT MM (est) 188 160 140 135 130 125	MM (act) 122.5 117.8 117.9 129.8 129.8  MM (act) 185.6 162.8 158.8 157.9
KDSI (est) 40 40 40 40 40 40 40 60 60 60 60 60 60 60 60 60 60 60 60 60	TDEV (est) 18.3 18.3 18.3 18.3 18.3 18.3 18.3 18.3	MM (est) 104.6 80 77.5 75 72.5 70 80  PROJECT MM (est) 229.9 200 180 170 167.5 165	MM (act) 104.3 93.5 93.6 94.2 95.1 96.4 #5 MM (act) 228.8 202.7 197.8 195.6	KDSI (est) 50 50 50 50 50 50 70 70 70 70 70	YCLE #4, F TDEV (est) 16.9 16.9 16.9 YCLE #4, F TDEV (est) 19.4 19.4 19.4 19.4 19.4	PROJECT MM (est) 122.7 100 96 90 60	MM (act) 122.5 117.8 117.9 129.8 129.8 144 MM (act) 185.6 162.8 158.8 157.9

C	YCLE #4, F	PROJECT	#1	C	YCLE #4, I	PROJECT	#5
KDSI (est)	TDEV (est)	MM (est)	MM (act)	KDSI (est)	TDEV (est)	MM (est)	MM (act)
40	16.4	92.3	92	80	19.8	199.9	199.1
40	16.4	70	86.9	80	19.8	170	185.4
40	16.4	67.5	86.5	80	19.8	160	182.9
40	16.4	65		80	19.8	157.5	182.3
40	16.4	60	88.6	80	19.8	155	And the second
40	16.4	50	94.6	80	19.8	150	182.3
				80	19.8	145	183.3
				80	19.8	140	184.3
				80	19.8	135	186.7
C	YCLE #4, F	PROJECT		C	YCLE #4, I	PROJECT	#3
	TDEV (est)		MM (act)		TDEV (est)		MM (act)
50	18.7	128	127.4	60	17.6	138.5	138.2
50	18.7	100	111.8	60	17.6	115	133.8
50	18.7	95	110.6	60	17.6	110	133.2
50	18.7	90		60	17.6	107.5	
50	18.7	<b>9</b> 5	110.9	60	17.6	105	133.2
50	18.7	80	113.1	60	17.6	100	133.7
				60	17.6	85	141.3
<del></del>	<del> </del>	<del></del>	<del></del>				<u> </u>
С	YCLE #5, F	PROJECT	#6	CY	CLE #5, P	ROJECT	#4
KDSI (eet)	TDEV (col)		MM (act)	KOSI (est)	TDEV (est)	MM (est)	MM (act)
KDSI (eet) 80	TDEV (eet) 19.9	MM (eqt) 215.1	MM (act) 201	KDS  (est) 70	TDEV (est) 18.3	MM (est) 154.4	MM (act) 153.9
KDSI (eet) 80 80	19.9 19.9	MM (egt) 215.1 185	MM (act) 201 184.3	KDSI (est) 70 70	1DEV (est) 18.3 18.3	MM (est) 154.4 130	MM (act)
KDSI (est) 80 80 80	19.9 19.9 19.9	MM (est) 215.1 185 155	MM (act) 201 184.3 173.6	KDSI (est) 70 70 70	TDEV (est) 18.3 18.3 18.3	MM (est) 154.4 130 120	MM (ect) 153.9 149.3
KDSI (eel) 80 80 80 80 80	19.9 19.9 19.9 19.9	185 155 145	MM (act) 201 184.3	KDSI (est) 70 70	1DEV (est) 18.3 18.3	MM (est) 154.4 130	MM (act) 153.9
KDSI (eet) 80 80 80 80 80	19.9 19.9 19.9 19.9 19.9	MM (est) 215.1 186 155 145 142.5	MM (act) 201 184.3 173.6 171.8	KDSI (est) 70 70 70	TDEV (est) 18.3 18.3 18.3	MM (est) 154.4 130 120	MM (ect) 153.9 149.3
KDSI (eet) 80 80 80 80 80 80	19.9 19.9 19.9 19.9 19.9 19.9	MM (eqt) 215.1 186 156 145 142.5 140	MM (sct) 201 184.3 173.6 171.8	KDSI (est) 70 70 70	TDEV (est) 18.3 18.3 18.3	MM (est) 154.4 130 120	MM (ect) 153.9 149.3
80 80 80 80 80 80 80	19.9 19.9 19.9 19.9 19.9	MM (est) 215.1 186 155 145 142.5	MM (act) 201 184.3 173.6 171.8	KDSI (est) 70 70 70	TDEV (est) 18.3 18.3 18.3	MM (est) 154.4 130 120	MM (ect) 153.9 149.3
KDSI (eet) 80 80 80 80 80 80	19.9 19.9 19.9 19.9 19.9 19.9	MM (eqt) 215.1 186 156 145 142.5 140	MM (sct) 201 184.3 173.6 171.8	KDSI (est) 70 70 70	TDEV (est) 18.3 18.3 18.3	MM (est) 154.4 130 120	MM (ect) 153.9 149.3
KDSI (eet) 80 80 80 80 80 80	19.9 19.9 19.9 19.9 19.9 19.9	MM (eqt) 215.1 186 156 145 142.5 140	MM (sct) 201 184.3 173.6 171.8	KDSI (est) 70 70 70	TDEV (est) 18.3 18.3 18.3	MM (est) 154.4 130 120	MM (ect) 153.9 149.3
RDSI (eqt) 80 80 80 80 80 80	19.9 19.9 19.9 19.9 19.9 19.9	MM (cgt) 215.1 185 155 145 142.5 140 130	MM (act) 201 184.3 173.6 171.8	KDSI (est) 70 70 70 70 C	TDEV (est) 18.3 18.3 18.3 18.3 YCLE #5, I	MM (est) 154.4 130 120 110 PROJECT	MM (act) 153.9 149.3 149.7
RDSI (est) 80 80 80 80 80 80 80 C	19.9 19.9 19.9 19.9 19.9 19.9 19.9	MM (cat) 215.1 185 155 146 142.5 140 130 PROJECT	MM (act) 201 184.3 173.6 171.8 174.4	KDSI (est) 70 70 70 70 C	TDEV (est) 18.3 18.3 18.3	MM (est) 154.4 130 120 110  PROJECT MM (est)	MM (act) 153.9 149.3 149.7
KDSI (est) 80 80 80 80 80 80 80 CC KDSI (est)	1DEV (cet) 19.9 19.9 19.9 19.9 19.9 19.9 YCLE #5, I	MM (cat) 215.1 185 155 145 142.5 140 130 PROJECT MM (cat)	MM (act) 201 184.3 173.6 171.8 174.4 #2 MM (act) 111.1	KDSI (est) 70 70 70 70 70 CC KDSI (est) 60	TDEV (est) 18.3 18.3 18.3 18.3  YCLE #5, I	MM (est) 154.4 130 120 110  PROJECT MM (est) 151.9	MM (act) 153.9 149.3 149.7 149.7
KDSI (est) 80 80 80 80 80 80 80 80 50	1DEV (cct) 19.9 19.9 19.9 19.9 19.9 19.9 19.9 YCLE #5,   TDEV (cct) 16.9	MM (cat) 215.1 185 155 146 142.5 140 130 PROJECT MM (cat) 111.6	MM (act) 201 184.3 173.6 171.8 174.4 174.4  MM (act) 111.1 106.1	KDSI (est)	TDEV (est) 18.3 18.3 18.3 18.3  YCLE #5, ITDEV (est) 19.1	MM (est) 154.4 130 120 110  PROJECT MM (est) 151.9 120	MM (act) 153.9 149.3 149.7 4/3 MM (act) 144.8 128.9
KDSI (est) 80 80 80 80 80 80 80 50 50 50	1DEV (cct) 19.9 19.9 19.9 19.9 19.9 19.9 YCLE #5,   TDEV (cct) 16.9 16.9	MM (cat) 215.1 185 155 145 142.5 140 130  PROJECT MM (cat) 111.6 100 90	MM (act) 201 184.3 173.6 171.8 174.4 174.4  MM (act) 111.1 106.1 104.6	KDSI (est) 70 70 70 70 70 CC KDSI (est) 60 60	TDEV (est) 18.3 18.3 18.3 18.3  YCLE #5, I	MM (est) 154.4 130 120 110  PROJECT MM (est) 151.9 120 110	MM (act) 153.9 149.3 149.7 149.7
KDSI (est) 80 80 80 80 80 80 80 80 50 50 50	1DEV (cct) 19.9 19.9 19.9 19.9 19.9 19.9 19.9 YCLE #5,   TDEV (cct) 16.9 16.9	MM (cat) 215.1 185 155 145 140 130  PROJECT MM (cat) 111.6 100 90 86	MM (act) 201 184.3 173.6 171.8 174.4 174.4  MM (act) 111.1 106.1	KDSI (est)	TDEV (est) 18.3 18.3 18.3 18.3 18.3 18.3 19.1 19.1 19.1 19.1	MM (est) 154.4 130 120 110  PROJECT MM (est) 151.9 120 110 105	MM (act) 153.9 149.3 149.7 149.7 149.7 149.7 149.7 149.7 149.7 149.7 149.8
KDSI (est) 80 80 80 80 80 80 80 CC KDSI (est) 50 50 50	1DEV (cct) 19.9 19.9 19.9 19.9 19.9 19.9 19.9 YCLE #5,   IDEV (cct) 16.9 16.9 16.9	MM (cst) 215.1 185 155 145 142.5 140 130  PROJECT MM (cst) 111.8 100 90 85 80	MM (act) 201 184.3 173.6 171.8 174.4 174.4  MM (act) 111.1 106.1 104.6 103.7	KDSI (est)	TDEV (est) 18.3 18.3 18.3 18.3 18.3  YCLE #5, I TDEV (est) 19.1 19.1 19.1 19.1	MM (est) 154.4 130 120 110  PROJECT MM (est) 151.9 120 110 105 100	MM (act) 153.9 149.3 149.7 149.7 149.7 149.7 149.7 144.8 128.9 128.8
KDSI (est) 80 80 80 80 80 80 80  80  80  50 50 50 50 50	1DEV (cct) 19.9 19.9 19.9 19.9 19.9 19.9 19.9 YCLE #5,   IDEV (cct) 16.9 16.9 16.9 16.9	MM (cat) 215.1 185 155 145 144.5 140 130  PROJECT MM (cat) 111.8 100 90 85 80 75	MM (act) 201 184.3 173.6 171.8 174.4 174.4  MM (act) 111.1 108.1 104.6 103.7	KDSI (est)	TDEV (est) 18.3 18.3 18.3 18.3 18.3  YCLE #5, I TDEV (est) 19.1 19.1 19.1 19.1	MM (est) 154.4 130 120 110  PROJECT MM (est) 151.9 120 110 105 100 95	MM (act) 153.9 149.3 149.7 149.7  MM (act) 144.8 128.9 126.8
KDSI (est) 80 80 80 80 80 80 80 CC KDSI (est) 50 50 50	1DEV (cct) 19.9 19.9 19.9 19.9 19.9 19.9 19.9 YCLE #5,   IDEV (cct) 16.9 16.9 16.9	MM (cst) 215.1 185 155 145 142.5 140 130  PROJECT MM (cst) 111.8 100 90 85 80	MM (act) 201 184.3 173.6 171.8 174.4 174.4  MM (act) 111.1 106.1 104.6 103.7	KDSI (est)	YCLE #5, I 19.1 19.1 19.1 19.1 19.1 19.1 19.1	MM (est) 154.4 130 120 110  PROJECT MM (est) 151.9 120 110 105 100 95 90	MM (act) 153.9 149.3 149.7 149.7  M3 MM (act) 144.8 128.9 126.8 128.1 128.1
KDSI (est) 80 80 80 80 80 80 80  80  80  50 50 50 50 50	1DEV (cct) 19.9 19.9 19.9 19.9 19.9 19.9 19.9 YCLE #5,   IDEV (cct) 16.9 16.9 16.9 16.9	MM (cat) 215.1 185 155 145 144.5 140 130  PROJECT MM (cat) 111.8 100 90 85 80 75	MM (act) 201 184.3 173.6 171.8 174.4 174.4  MM (act) 111.1 108.1 104.6 103.7	KDSI (est)	TDEV (est) 18.3 18.3 18.3 18.3 18.3  YCLE #5, I TDEV (est) 19.1 19.1 19.1 19.1	MM (est) 154.4 130 120 110  PROJECT MM (est) 151.9 120 110 105 100 95	MM (act) 153.9 149.3 149.7 149.7  MM (act) 144.8 128.9 126.8

15.5	MM (est) 85.1	MM (act) 84.9
	85.1	94.0
		<del>07</del> .5
15.5	70	82.5
15.5	65	81.5
15.5	62.5	81
15.5	60	Carlos - in china
15.5	55	82.9
15.5	50	86.4
	15.5 15.5 15.5 15.5	15.5 65 15.5 62.5 15.5 60 15.5 55

## APPENDIX C. NORMALIZATION CALIBRATION STRATEGY: BASE CASE

	<del></del>		<del></del>	YCLE #16R	O\	<del></del>						T
				•	-							
Pro Serial	DEPIK (S)	KDSI (act)	Under (%)					MA (act)	TUEV (act)			L
1	100	40	40	24	67.5	12.4		120.9	18.5			<b></b>
2	100	50	20 30	40	115.4	15.2		149.7	18.6			<del> </del>
3	100	80 70	30	35	121.5	15.5		245.B	19.9	<b></b>	<del> </del>	<del> </del>
5	100	80	10	72	214	192		2423	223		ļ	<del> </del>
					217	194		2-42-0				<del></del>
Per 19-1-1	(DSI (ed)	MM (emb	Millact	Millinores)	0	V 175733	eum Miliari)"Q	02	mm 0*2	السائد سنرها	Production	Come Prod
1	40	115.4	120.5	112.6	48	5466	5405	2304	2304		0.33	Comp Prod
2	50	145.9	149.7	142.5	61	8693	14006	3721	6025		0.33	
3	80	176.7	187.6	172.8	74	12787	20005	5476	11501		0.32	
4	70	207.8	245.8	204.4	87	17783	44666	7560	19070		0.28	
5	80	239	242.3	236.4	100	23640	66506	10000	29070	2.35	0.33	0.317
						L						
				<del></del>					<del></del>	<b></b>		<del></del>
	<u> </u>			<u> </u>			<u></u>	<u> </u>			<del> </del>	
			CYC	LE #2 (Nom	ellend Di	eden)				<b></b>		<del> </del>
200		0.67.1	17.	(1) 1 /~- X		MD 37/7		10-	TUEV (act)			<del></del>
7	120	50	40	30	83.6	13.4		1427	18.3		<del></del>	<del></del>
1	120	40	10	38	101.2	14.5		107.8	16.3			1
3	120	80	20	48	138.9	16.2		166.9	18.6			1
5	120	80	50	40	113	15.1		217.9	21.4			Ī
4	120	70	30	40	130.0	16.3		207.7	19.8			
	CONTRACT.			1282	0	<u>.</u> 1 ~						Come Prod
_ <del></del>	50	142.9	142.7	100.5	81	7620	7620	2304	3/21		0.36	
$-\frac{1}{3}$	40	113	107.6	166.6	74	11514	12669	5476	11501		0.37	ļ
<del>- 3</del>	86	234.1	277.9	212.7	100	21270	46447	10000	21501	ļ	0.29	
	76	203.4	207.7	163.6	67	19001	81438	7980	20070	2.11	0.34	0.333
			47.1	1334			V:	1.00		-	V-7-	Y 2000
	!	·		<del>!</del>					<del> </del>		<del></del>	
						† <del></del>				<del></del>		<del> </del>
			CYC	LE #3 Otom					*			1
											<u> </u>	
Park Series	DECEMBED		<b>11.7</b> Tel	1.0.17		PAYT		1.1	N.P. AV			
4	140	70	20		144.5	16.5		1821	19.2		<b></b>	<del></del>
3	140	60	40	35	90.9	13.9		104.5	18.3		<del></del>	
<del>- }-</del>	140	40 50	90 10	20 45	114.9	11		122.7	16.3		<del></del>	<del> </del>
<del>- { -</del>	140	80	35	<del>  2  </del>	1413	18.5		235	20.4		<del> </del>	+
					-						<del></del>	<del> </del>
-	100 64	1117			a	1	1000	92	m 02	Contract of	F-3-3-3	Comp Page
- 4	70	1127	121	140	67	14708	14763	700			0.35	
3	66	155.4	164.3	142.8	74	1 46/407	26270	5476	130-45		0.58	
1	46	101.5	104.6	93.4	46	4483	28753	2304	15546		0.50	
- 2	50	12.3	127	117.3	61	7188	34000	3721	19070	- 22	0.41	
5	- 60	210.1	2213	198.5	100	19540	348	10000	29070	1,04	0.36	0.373
	<del>                                     </del>	<del></del>	<b></b>		<del> </del>	<del> </del>			<del></del>	<del></del>	<del></del>	<b></b> -
	<del> </del>	<del></del>		<del> </del>	<del>i</del>	<del> </del>		<del></del>	<del>•</del>		<del></del>	<del> </del>
	<u> </u>	·	<u></u>	<u> </u>		<u> </u>	<u> </u>		<del></del>		<del> </del>	<del> </del>
				LE #4 Plans						<b></b>	<del>}</del>	<del></del>
	D. BLOS	10 S 446	Umar (A)	10,200		J.P. BY COM			HUEV TO			!
-	160	70	40	2	1 11 2	143		188	19.4			
1	160	40	30	28	84.2	122		623	18.4		<u> </u>	
5	160	80	20	25	152.9	16.9		199.5	19.8			i
2	190	50	50		57	11.6		128	18.7			
3	140	- 60	10	H	127.9	16.4		138.5	17.4			
REAL PROPERTY.	NAME OF STREET											
	70	167.5	165	157.4	- U	4147	17841	7689 2364	7500		0.37	<del> </del>
<del>- 1</del>	40	198.2	199.9	122	100	18200	36041	10000	16673	<u> </u>	0.43	<del>;</del> _
3	55	116	128	110.1	81	6716	42757	3721	23604	<del></del>	0.30	<del> </del>
	80	142.8	138.5	132.6	74	5912	52560	5476	29070	1.81	0.43	0.402
												4

			CYC	LE #6 (Nome	mailzed C	inte)					<del> </del>	
Pig Seld	DSPTK(%)	KOS (ad)	Under (%)	KOSI (est)	MAN (See	VE VE		MM (act)	TOEV (ect)			
5	180	80	40	48	105.4	14.7		215.1	19.9			
4.	180	70	10	63	140.3	16.4	•	154.4	18.3			
2	180	50	30	36	75.7	12.9		111.6	16.9			
3	180	60	50	30	64.4	12.2	•	151.9	19.1			
1	180	40	20	32	66.9	12.5		85.1	15.5			
Pari Santal	KDSI (act)	Maria Caral	Mari	Margarette)	0	Market	eum Millacii C	02	em 0/2	Conficient	Productivity	Como Prod
5	80	180.3	215.1	171.5	100	17150	17150	10000	10000		0.37	
4	70	156.7	154.4	147.6	87	12641	29991	7500	17589		0.45	
2	50	110.1	111.6	102.9	61	6277	36266	3721	21290		0.45	
3	60	133.3	151.9	126.1	74	9331	45500	5476	26766		0.39	
1	40	87.1	86.1	81	48	3886	49487	2304	29070	1.7	0.47	0.418
			CYC	LE #6 (Norm	nelized ()	lector)						
المساف المساف	DSPIK(%)	Was look	The section (SE)	Market /cont	10.00	All The Vice	<del></del>	W (2-1)	TOEV (act)			
144	200	40	40	24	473	10.9		84.1	16.7			
	200	50	20	40	81.8	13.3		103.2	16.2			
3	200	80	30	10	86.1	13.6		130.9	17.5		<del></del>	
4	200	70	50	35	71.1	12.6		176.6	19.5			
5	200	90	10	72	151.5	16.9		170	9			
Pro Sorta	NOS Gods	NAME (COME)	Miles	Militagray	0	Marie C	ours Militarii C	02	was C*2	Coefficient	Productivity	Comp Prod
1	40	81.8	84.1		48	0	0	2304	2304		0.48	
2	50	103.4	103.2		61	0	0	3721	6025		0.48	
3	80	125.2	130.9		74	0	0	5476	11501		0.46	
4	70	147.2	176.6		87	0	0	7589	19070		0.4	
5	80	169.3	170		100	0	0	10000	29070	0	0.47	0.451

# APPENDIX D. CONVENTIONAL CALIBRATION STRATEGY: LEARNING - NO UNDERSIZING

1			CLE #1 (Re		IN POSE, 11/2		13)				
Act Series	DEPTK	校园 (金)	Under (%)	KUSI (GI)	MJ (40)	15.2		MAX (act)	TUEY (SE)		
1	100	40	0	40	115.4			115.4	16.5		
2	100	50	0	50	145.9	16.6		146.9	17.9		
3	100	80	0	60	176.7	17.9		178.3	19.4		
_4	100	70	0	70	207.8	19		212	20.7		
	100	80	0	80	230	20	L	248.7	21.9	<b>!</b>	
TO Said	Mari Carl	Mass	The second	a	La Constitution	BURN MARKET C	0.5	- C	Continue	Productivity	Anna Barre
***************************************	40	115.4	115.4	48	5550	5339	2301	234	-	0.35	CONTRA
<del>- ż</del>	50	145.9	145.9	61	8800	14439	3721	6025	<del> </del>	0.34	
<del></del>	60	176.7	178.3	74	13194	27633	5476	11501		0.34	
4	70	207.8	212	87	18444	46077	7589	19070		0.33	
5	80	230	246.7	100	24670	70747	10000	29070	243	0.32	0.334
	<b></b>	<del></del>	ļ	<u> </u>		Ļ		<b></b>			
	<u>:</u>	<u>i</u>	<u> </u>		<u> </u>	<u> </u>		L	<u>.                                    </u>		
		CVI	CLERS (R	w Dute, 120	% DSIPTK,	NO UNDERSIZII	NG)				·
المالية والمالة	I SUIT A	KINST /		HOS CON	100	TUEV (cet)		THE COUNTY	TUEV (act)		
2	120	50	0 17/	50	147.7	18.7		347.3	17.9	<b></b>	
<del></del>	120	40	0	40	116.9	15.3		118.6	16.6	<b></b>	
3	120	60	0	60	178.9	17.9		178.2	19.1		
5	120	80	0	80	242	20.1		241.2	21.3		
4	120	70	0	70	210.4	19.1		209.7	20.3		
Proj Series	NOS (ad)	MAI (est)	Mark		MMIactro	Sum Margact C	0.5	sum Q'2	Coefficient	Productivity	Comp Pro
- 2	90 40	116.9	147.3 118.6	81 48	5507	8985 14582	3721 2304	3721 8025	ļ ———	0.34	
-3-	<del>- 2</del> -	178.9	178.2	74	13187	27760	5476	11501	<del> </del>	0.34	
-3-	<del></del> 6	242	241.2	100	24120	51869	10000	21501	<del></del>	0.33	
-3	<del></del>	210.4	209.7	87	18244	70133	7580	29070	241	0.33	0.336
	<u>:                                 </u>			<del>                                     </del>	1						
	•	<del></del>		<del> </del>					1		
							1 _			1	
		CY	CIF#3 (R	w Data, 140	& DSIPTK	NO UNDERSIZE	4G)	<del>'</del>	<del></del>		
						NO UNDERSIZI	vG)				
Pro Sens		LOSI (GC)	Under (%)	KOSI (est)	MM (est)	TUEV (GET)	(G)		IDEV (SE)		
4	140	1081 (cd) 70	Under (%)	KOSI (est)	208.6	10EV (981)	(G)	208.1	20.1		
To Sens	140	70 70 60	Under (%)	KUSI (est) 70 80	208.6 177.4	10EV (981) 19 17.9	(G)	208.1 174.4	20.1 18.9		
4	140 140	70 60 40	Under (%)	70 80 40	208.6 177.4 115.9	10EV (est) 19 17.9 15.2	(G)	208.1 174.4 112.7	20.1 18.9 16.1		
4	140 140 140	70 70 60 40 50	Under (%)	70 80 40 50	MM (est) 208.6 177.4 115.9 146.5	10EV (est) 19 17.9 15.2 16.6	(G)	208.1 174.4 112.7 143.2	20.1 18.9 16.1 17.5		
3 1 2 5	140 140 140 140	10 SI (62) 10 80 40 50 80	0 0 0 0 0	KQSi (ast) 70 80 40 50	208.6 177.4 115.9	10EV (est) 19 17.9 15.2	(G)	208.1 174.4 112.7	20.1 18.9 16.1		
3 1 2 5	140 140 140 140	70 80 40 50 80 80	0 0 0 0 0	70 80 40 50 60	MM (est) 208.6 177.4 115.9 148.5 240	1DEV (get) 19 17.9 15.2 16.6 20.1	07/2	208.1 174.4 112.7 143.2 237.4	20.1 18.9 16.1 17.5 21.2	Productivity	Comp Pro
3 1 2 5	140 140 140 140 140 170	WDSI (6ct) 70 60 50 50 80 MM (6st) 208.8	Under (%) 0 0 0 0 0 0 0 0 0 0 0 208.1	KC)Si (ast)   70   80   40   50   80   C	MM (est) 208.6 177.4 115.9 148.5 240 MM/act/f*C	17.9 15.2 16.6 20.1		208.1 174.4 112.7 143.2 237.4 Exim Q*2	20.1 18.9 16.1 17.5 21.2	Productivity 0.34	Comp Pro
3 1 2 5 5 Fro I Same	140 140 140 140 140 170 170	POSI (sec) 70 60 40 50 60 60 MM (sec) 208.6	Under (%) 0 0 0 0 0 0 0 0 0 0 1 0 208.1	KQSI (set)   70   60   40   50   60   0   87   74	MM (cet) 208.6 177.4 115.9 146.5 240 MM/act/*0 17851 12808	10.5 (98) 19. 17.9 15.2 16.6 20.1 20.1 20.1 20.1 20.1 20.1	7°2 7589 5478	208.1 174.4 112.7 143.2 237.4 Esm Q*2 7589 13045	20.1 18.9 16.1 17.5 21.2	Productivity 0.34 0.34	Comp Pio
3 1 2 5 70 Sens	140 140 140 140 140 140 80\$1 (act) 70 60	70 60 40 50 60 80 208.8 177.4 115.9	Under (%) 0 0 0 0 0 0 0 0 0 1 174.4 112.7	(C)Si (est) 80 40 50 60 60 60 60 60 60 60 60 60 6	MM (cat) 208.6 177.4 145.9 146.5 249 MMacch*C 17831 12008 5410	1DEV (68) 19 17.9 15.2 16.6 20.1 17.83 30.837 3.8247	→ → → → → → → → → → → → → → → → → → →	208.1 174.4 112.7 143.2 237.4 eam Q*2 7586 13045 15340	20.1 18.9 16.1 17.5 21.2	Productivity 0.34 0.34 0.56	Comp Pro
3 1 2 5 70 Sens 4 3 1	140 140 140 140 140 160 170 60 60 40	70 60 40 50 60 60 208.8 177.4 115.9 146.5	Under (%) 0 0 0 0 0 0 0 0 0 208.1 174.4 112.7 143.2	(C)Si (cst) 70 80 40 50 80 80 80 87 74 48 61	208.6 177.4 115.9 148.5 240 17831 12808 5410 8735	1DEV (est) 19 17.9 15.2 16.6 20.1 17351 30637 36247 44862	7°2 7585 5478 2304 3724	208.1 174.4 112.7 143.2 237.4 eam Q*2 7589 13045 15349 19070	20.1 18.9 16.1 17.5 21.2	Productivity 0.34 0.35 0.36	
3 1 2 5 70 Sense 4 3	140 140 140 140 140 140 80\$1 (act) 70 60	70 60 40 50 60 80 208.8 177.4 115.9	Under (%) 0 0 0 0 0 0 0 0 0 1 174.4 112.7	(C)Si (est) 80 40 50 60 60 60 60 60 60 60 60 60 6	MM (cat) 208.6 177.4 145.9 146.5 249 MMacch*C 17831 12008 5410	1DEV (68) 19 17.9 15.2 16.6 20.1 17.83 30.837 30.837	→ → → → → → → → → → → → → → → → → → →	208.1 174.4 112.7 143.2 237.4 eam Q*2 7586 13045 15340	20.1 18.9 16.1 17.5 21.2	Productivity 0.34 0.34 0.56	Correo Pro
3 1 2 5 70 Sens 4 3 1	140 140 140 140 140 160 170 60 60 40	70 60 40 50 60 60 208.8 177.4 115.9 146.5	Under (%) 0 0 0 0 0 0 0 0 0 208.1 174.4 112.7 143.2	(C)Si (cst) 70 80 40 50 80 80 80 87 74 48 61	208.6 177.4 115.9 148.5 240 17831 12808 5410 8735	1DEV (est) 19 17.9 15.2 16.6 20.1 17351 30637 36247 44862	7°2 7585 5478 2304 3724	208.1 174.4 112.7 143.2 237.4 eam Q*2 7589 13045 15349 19070	20.1 18.9 16.1 17.5 21.2	Productivity 0.34 0.35 0.36	
3 1 2 5 70 Sens 4 3 1	140 140 140 140 140 160 170 60 60 40	70 60 40 50 60 60 208.8 177.4 115.9 146.5	Under (%) 0 0 0 0 0 0 0 0 0 208.1 174.4 112.7 143.2	(C)Si (cst) 70 80 40 50 80 80 80 87 74 48 61	208.6 177.4 115.9 148.5 240 17831 12808 5410 8735	1DEV (est) 19 17.9 15.2 16.6 20.1 17351 30637 36247 44862	7°2 7585 5478 2304 3724	208.1 174.4 112.7 143.2 237.4 eam Q*2 7589 13045 15349 19070	20.1 18.9 16.1 17.5 21.2	Productivity 0.34 0.35 0.36	
3 1 2 5 5 Pro Seriel 4 3 1	140 140 140 140 140 160 170 60 60 40	MM (cot) 146.5 240	Under (%) 0 0 0 0 0 0 0 0 0 0 174.4 112.7 143.2 237.4	(C2S) (set) 70 60 40 50 60 60 60 60 60 67 74 48 61 100	MM (eat) 208.6 177.4 115.9 148.5 249 MM(ect)*C 17931 12008 5410 8735 237**)	1DEV (est) 19 17.9 15.2 16.6 20.1 17831 30837 30837 44582 66722	\$272 7,589 5476 2304 3721 10000	208.1 174.4 112.7 143.2 237.4 eam Q*2 7589 13045 15349 19070	20.1 18.9 16.1 17.5 21.2	Productivity 0.34 0.35 0.36	
4 3 1 2 5 5 Pro S 10 4 3 1 2 5	140 140 140 140 140 100\$1 (act) 70 60 40 50	MM (set) 146.5 240	Under (%) 0 0 0 0 0 0 0 0 0 174.4 112.7 143.2 237.4	KO2Si (set)   70   80   40   50   60   60   60   60   60   60   6	MM (eat) 208.6 177.4 115.9 148.5 249 MM/(act)*C 17931 12808 5410 8735 237*)	1DEV (ett) 19 17.9 15.2 16.6 20.1 1763 30837 4582 65722	\$272 7,589 5476 2304 3721 10000	208.1 174.4 112.7 143.2 237.4 Pam CP2 7589 13045 15349 19070 28070	20.1 18.9 16.1 17.5 21.2 Conflictor(	Productivity 0.34 0.35 0.35 0.36	
4 3 1 2 5 5 Pro S 10 4 3 1 2 5	146 146 146 140 140 100 100 100 100 100 100 100 100	MM (cot) 115.9 146.5 240 KOSI (cot)	Under (%) 0 0 0 0 0 0 0 0 174.4 174.2 237.4 CLE #4 (Re	(CDS) (cot) 70 60 40 50 60 60 60 60 60 61 74 46 61 100 61 100	MM (sat) 208.6 177.4 115.9 148.5 240  MMMacd**C 17931 12808 5410 8735 237**)	1DEV (est) 19 17.9 15.2 16.6 20.1 17431 30637 36247 44862 66772	\$272 7,589 5476 2304 3721 10000	208.1 174.4 112.7 143.2 237.4 Rem Q*2 7589 13045 15340 16070 25070	20.1 18.9 16.1 17.5 21.2 Conflictors 2.36	Productivity 0.34 0.35 0.35 0.36	
4 3 1 2 5 Prol Sana 4 3 1 2 5	146 146 146 146 146 160 160 160 160 160	MAY (cot) 208.6 177.4 115.9 146.5 240  CY/	Under (%) 0 0 0 0 0 0 208.1 174.4 112.7 143.2 237.4 Under (%)	KOSS (cet)   70   80   40   50   60   60   60   60   60   60   6	MM (set) 208.6 177.4 115.9 148.5 240 MM(set) 17831 12908 9410 8735 237*) M DSIPTK M Leet) 204.3	1DEV (98) 19 17.9 15.2 16.6 20.1  Sum MM(20)** 1783* 30837 38247 44882 86722  NO UNDERSIZE 18.9	\$272 7,589 5476 2304 3721 10000	208.1 174.4 112.7 143.2 237.4 9am Q*2 7589 13045 15349 16070 28070	20.1 18.9 16.1 17.5 21.2 Confident	Productivity 0.34 0.35 0.35 0.36	
3 1 2 5 5 Pro Sand 4 3 1 2 5 5 Pro Sand 4 1 1 2 5 5 Pro Sand 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	146 146 146 146 146 160 160 160 160	MM (sept) 208.8 177.4 115.9 146.5 240 CY	Under (%)  0  0  0  0  0  0  0  0  208.1  174.4  112.7  143.2  237.4  Under (%)  0  0	KO2SI (set)   70   80   40   50   60   60   60   60   60   60   6	MM (eat) 208.6 177.4 115.9 148.5 249  MM/GCGCC 17831 12808 5410 6735 237*3  MSSIPTR, MM (eat) 201.3 113.5	1DEV (98) 19 17.9 15.2 16.6 20.1  Sum MM(sct)*C 17631 30837 36837 44882 68722  MO UNDERSIZE 18.9 15.1	\$272 7,589 5476 2304 3721 10000	208.1 174.4 112.7 143.2 237.4 9am Q*2 7589 13045 15349 19070 28070	20.1 18.9 16.1 17.5 21.2 Coefficient	Productivity 0.34 0.35 0.35 0.35	
4 3 1 2 5 5 Pro Sense 4 3 1 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	140 140 140 140 140 100 100 100 100 100	MM (ext) 70 60 60 60 60 60 60 60 60 60 60 60 60 60	Under (%) 0 0 0 0 0 0 0 0 174.4 174.2 237.4  CLE #4 (R) Under (%) 0 0	(CDS) (eat) 70 60 40 50 60 60 60 60 61 74 46 61 100 61 100 70 70 60	MM (sat) 208.6 177.4 115.5 240 17831 12008 8735 237*2) M DSIPTK 201.3 113.5 225	1DEV (est) 19 17.9 15.2 16.6 20.1 182m MMacti C 17231 30637 38247 44582 66722  NO UNDERSIZE 15.1 16.1	\$272 7,589 5476 2304 3721 10000	208.1 174.4 112.7 143.2 237.4 8am O*2 7589 13045 15349 16070 28070	20.1 18.9 16.1 17.5 21.2 Conflictors 2.36	Productivity 0.34 0.35 0.35 0.35	
4 3 1 2 5 Proj.Santa 4 3 1 2 5 5	146 146 146 146 146 170 60 60 50 80 80 90 160 160 160	CY/  KOSI (act)  70  60  40  50  50  MM (cat)  177.4  115.9  146.5  240  CY/  KOSI (act)  70  40  50  50	Under (%) 0 0 0 0 0 0 208.1 174.4 112.7 143.2 237.4  Under (%) 0 0 0	KOSS (cet)   70   80   40   50   60   60   60   60   60   60   6	MM (sat) 208.6 177.4 115.9 148.5 240  MM(sc) 17831 12008 5410 8735 237*/)  ** DSIPTIK 201.3 113.5 235 143.5	1DEV (68) 19 17.9 15.2 16.6 20.1    Sum MM(63)** 17831 30637 38247 44982 66722  NO UNDERSIZE 15.1 19.9 16.5	\$272 7,589 5476 2304 3721 10000	208.1 174.4 112.7 143.2 237.4 Rem CP2 7589 13045 15349 18070 25070 25070	20.1 18.9 16.1 17.5 21.2 Condicional 2.38 TDEV (act) 19.4 15.7 17	Productivity 0.34 0.35 0.35 0.35	
4 3 1 2 5 5 Pro Sense 4 3 1 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	140 140 140 140 140 100 100 100 100 100	MM (ext) 70 60 60 60 60 60 60 60 60 60 60 60 60 60	Under (%) 0 0 0 0 0 0 0 0 174.4 174.2 237.4  CLE #4 (R) Under (%) 0 0	(CDS) (eat) 70 60 40 50 60 60 60 60 61 74 46 61 100 61 100 70 70 60	MM (sat) 208.6 177.4 115.5 240 17831 12008 8735 237*2) M DSIPTK 201.3 113.5 225	1DEV (est) 19 17.9 15.2 16.6 20.1 182m MMacti C 17231 30637 38247 44582 66722  NO UNDERSIZE 15.1 16.1	\$272 7,589 5476 2304 3721 10000	208.1 174.4 112.7 143.2 237.4 8am O*2 7589 13045 15349 16070 28070	20.1 18.9 16.1 17.5 21.2 Conflictors 2.36	Productivity 0.34 0.35 0.35 0.35	
4 3 1 2 5 5 Pro Sond 4 3 1 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	140 146 146 146 146 160 160 160 160 160	NOSI (ect)   70   60   60   60   60   60   60   60	Under (%) 0 0 0 0 0 0 0 0 0 174.4 174.2 237.4  Under (%) 0 0 0 0 0	(C)Si (cet) 70 60 40 50 60 60 60 60 60 61 100 61 100 61 60 60 60	MM (sat) 208.6 177.4 115.5 240 17851 12806 8735 237°) 78 DSIPTK 201.3 113.5 225 143.5 173.8	1DEV (est) 19 17.9 15.2 16.6 20.1 182m MMacti C 17231 30637 38247 44582 66722  NO UNDERSIZE 15.1 19.9 16.5 17.7	→ P 7585 5476 2304 3721 10000	208.1 174.4 112.7 143.2 237.4 8am O*2 7589 13045 15349 19070 28070 28070	20.1 18.9 16.1 17.5 21.2 Conflictors 2.38	Productivity 0.34 0.35 0.35 0.35	0.343
4 3 1 2 5 5 Pro Sand 4 3 1 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	140 140 140 140 140 160 160 160 160 160	POSI (ect) 70 60 40 50 60 MM (est) 208.6 177.4 115.9 146.5 240  CY0 40 80 50 60	Under (%) 0 0 0 0 0 0 208.1 174.4 112.7 143.2 237.4  Under (%) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	(C)Si (cet) 70 60 40 50 60 60 60 60 61 100 61 100 60 60 60 60	MM (sat) 208.6 177.4 195.9 148.5 240  MMMacd**C 17931 12008 8735 237**)  M DSIPTK  M DSIPTK  173.6 173.8	1DEV (98) 19 17.9 15.2 16.6 20.1  Brown MM(601)*C 17831 30637 36247 44562 96722  NO UNDERSIZE 15.9 15.1 19.9 16.5 17.7	072 7585 5476 2304 3721 10000	208.1 174.4 112.7 143.2 237.4 Pam Q*2 7589 13045 15340 16070 25070 191.2 164.2 222.6 132.4 161.4	20.1 18.9 16.1 17.5 21.2 Conflictors 2.38	Productivity 0.34 0.34 0.35 0.35 0.36	0.343
4 3 1 2 5 5 Pro Sand 4 3 1 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	140 146 146 146 146 160 160 160 160 160	NOSI (ect)   70   60   60   60   60   60   60   60	Under (%) 0 0 0 0 0 0 0 0 0 174.4 174.2 237.4  Under (%) 0 0 0 0 0	(C)Si (cet) 70 60 40 50 60 60 60 60 60 61 100 61 100 61 60 60 60	MM (sat) 208.6 177.4 115.5 240 17851 12806 8735 237°) 78 DSIPTK 201.3 113.5 225 143.5 173.8	1DEV (est) 19 17.9 15.2 16.6 20.1 182m MMacti C 17231 30637 38247 44582 66722  NO UNDERSIZE 15.1 19.9 16.5 17.7	→ P 7585 5476 2304 3721 10000	208.1 174.4 112.7 143.2 237.4 8am O*2 7589 13045 15349 19070 28070 28070	20.1 18.9 16.1 17.5 21.2 Conflictors 2.38	Productivity 0.34 0.35 0.35 0.35	0.343
4 3 1 2 5 5 PTO STATE 4 3 1 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	146 146 146 146 146 146 160 60 60 60 60 60 60 60 60 60 60 60 60 6	KOSI (ect)   70   60   60   60   60   60   60   60	Under (%) 0 0 0 0 0 0 0 208.1 174.4 112.7 143.2 237.4  CLE #4 (Ro Under (%) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	KOSS (set)   70   60   60   60   60   60   60   60	MM (set) 208.6 177.4 115.9 148.5 240 17931 12908 5410 6735 237°) 201.3 113.5 226 143.5 143.5	1DEV (985) 17.9 17.9 15.2 16.6 20.1  Serin MASSEST (1885) 17835 30837 38837 44882 98722  NO UNDERSIZE 18.9 15.1 19.9 16.5 17.7	7°2 7'589 5478 2304 37721 10000	208.1 174.4 112.7 143.2 237.4 9am Q*2 7589 13045 15349 19070 29070 491.2 104.2 222.6 181.4	20.1 18.9 16.1 17.5 21.2 Conflictors 2.38	Productivity 0.34 0.34 0.35 0.35 0.36 0.37 0.37	0.343
4 3 1 2 5 5 Proj. Santa 4 3 1 1 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	146 146 146 146 146 160 160 160 160 160 160 160 160 160	ROSI (act)   70   60   60   60   60   60   60   60	Under (%) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	KO2SI (set)   70   60   40   50   60   61   100   60   50   60   60   60   60   60	MM (sat) 208.6 177.4 115.9 148.5 240 MM(sat) 17.8 12008 8735 237*)  MDSIPTK MM (sat) 201.3 113.5 235 143.5 173.8 MM(sat) 4 9002	1DEV (est) 19 17.9 15.2 16.6 20.1  BERN MMARCHY 4582 65722  NO UNDERSIZE 15.1 19.9 16.5 17.7  BERN MMARCHY 18.9 24836	722 7,589 5476 2304 3721 100000	208.1 174.4 112.7 143.2 237.4 13045 15046 16070 28070 28070 101.4 161.4 161.4 161.4 161.4 161.4 161.4	20.1 18.9 16.1 17.5 21.2 Conflictors 2.38	Productivity 0.34 0.35 0.35 0.36 0.34	0.343

		CY	CLE #5 (Ra	w Data, 1809	& DSIPTK. N	O UNDERSIZI	ING)			 	 -
Proj. Seni	al DSIPTK (9	() KDSI (act)	Under (%)	KDSI (est)	MM (est)	TDEV (est)	]	MM (act)	TDEV (act)	 	 
5	180	80	0	80	219.1	19.4		202 5	20.1		 
4	180	70	0	70	190.4	18.4		174.8	19	 	
2	180	50	0	50	133.8	16.1	1	121.5	16.6		 
3	180	60	0	60	162	17 3	<b>——</b>	148	17 8		
	180	40	0	40	105.8	14.7		95.6	15 3	 	 

Proj.Senal	KDSI (act)	MM (est)	MM(act)	0	MM(act)*Q	sum MM(act)*Q	Q^2	sum Q^2	Coefficient	roductivity	Comp Prod
5	80	219.:	202.5	100	20250	20250	10000	10000		04	
4	70	190.4	174.8	87	15208	35458	7569	17569		0.4	
2	50	133.8	121.5	61	7412	42870	3721	21290		0.41	
3	60	162	148	74	10952	53822	5476	26766		0.41	
1	40	105.8	95.6	48	4589	58411	2304	29070	2.01	0.42	0.404

:		CY	CLE #6 (Ra	w Data. 2009	& DSIPTK. N	O UNDERSIZI	NG)			
Proj Sen	al DSIPTK (%)	KDSI (act)	Under (%)	KDSI (est)	MM (est)	TDEV (est)	1	MM (act)	TDEV (act)	
1	200	40	0	40	96.7	14.2		87.7	14.9	
2	200	50	0	50	122.2	15.5		111.4	16.2	
3	200	60	0	60	148	16.7		135.3	17.3	
4	200	70	. 0	70	174	17.8	<b>—</b>	159.7	18.5	
5	200	80	0	80	200.2	18.7		184.6	19.4	

Pro Sene	KDSI (ect)	MAL (est)	Manager (tree)	Q	RAME ACT C	sum Milaci)	00-2	stem Q*2	Conficient Productivity Comp Pr
1	40	96.7	87.7	48	4210	4210	2304	2304	0.46
2	50	122.2	111.4	61	6795	11005	3721	6025	0.45
3	60	148	135.3	74	10012	21017	5476	11501	0.44
4	70	174	159.7	87	13894	34911	7569	19070	0.44
5	80	200.2	184.6	100	18460	53371	10000	29070	1.84 0.43 0.442

### APPENDIX E. NORMALIZATION CALIBRATION STRATEGY: LEARNING - NO UNDERSIZING

			E #1 (Norm									
y Sensi	DSIPTK (%)		Under (%)		MM (est)			MM (act)	TDEV (act)			
1	100	40	0	40	115.4	15.2		1154	16.5			
2	100	50	0	50	145 9	16.6		145 9	17.9	~	·	
3	100	70	0	60 70	176 7 207 8	17.9		178 3 212	19 4 20 7			
-	100	80		÷ - 80	239	20		246 7	21 9			
<del></del> -	100		<u>`</u>	- 50	236	. 20		240 /	2,3	L		
i Senal	KDSI (act)	MM (est)	MM(act)	MM(norm)	- 0	MM(norm)*Q	sum MM(norm)*Q	0*2	sum Q^2	Coefficient	Productivity	Como Ph
1	40	1154	1154	1128	48	5414	5414	2304	2304		0 35	
2	50	145 9	145 9	142 4	61	8686	14100	3721	6025		0 34	
3	60	176 7	178 3	172.8	74	12787	26887	5476	11501		0 34	
4	70	207 8	212	204 3	87	17774	44661	7569	19070		0 33	
5	80	239	246 7	236 5	100	23650	68311	10000	29070	2 35	0 32	0 334
	<del></del>	<del></del>	<del></del>									
		CYC	F #2 /Nor	neirzed Data	120% DS#	PTK. NO UNDE	RS(ZING)					
(Saine)	INCIDIN NO					TOEV (est)		MM (act)	TDEV (sci)			
2 2	120	50	CHARGE (%)	50	142.9	16.5		142.4	177			
1	120	40	<del>,                                    </del>	40	113	151		1126	164			
3	120	60	<del></del>	60	173	17.7		1726	189	·		
5	120	80	0	80	234.1	199		233 7	21 2			
4	120	70_	0	70	203 4	18 8		203 1	20 1			
	728.5	10.7	182	1.006		0.80/						_
Sensi	KDSI (act)	MM (est)	142 4	MM(norm) 127.9	61	7802	sum MM(norm)°Q 7802	3/21		Coefficient	0 35	Comp P
1	40	113	1126	101 2	48	4858	12660	2304	3721 6025		0 36	
3	60	173	1726	155 6	74	11514	24174	5476	11501		0 35	
5	80	234 1	233 7	212 9	100	21290	45464	10000	21501		0 34	
4	70	203 4	203 1	183 9	87	15999	61463	7569	29070		0.34	0 347
								/303	29070	2 11		
		CYCL				PTK. NO UNDE		7368	29010	211		
Senal	DSIPTK (%)	KDSI (act)	E#3 (Nor	nalized Data	140% DSII	PTK. NO UNDE		MM (act)	TDEV (act)	211		
4	140	KDSI (act) 70	E #3 (Norn	nalized Data KDSI (est) 70	140% DSIF MM (est) 182 7	PTK. NO UNDE TDEV (est)		MM (act)	TDEV (act)	211		V 347
3	140	KDSI (act) 70 60	E #3 (Norm	Maiszed Data KDSI (est) 70 60	140% DSIF MM (est) 182 7 155 4	PTK, NO UNDE TDEV (est) 18.1 17		MM (act) 182 1 154 7	TDEV (act) 19.3 18.2	211		<u> </u>
3	140 140 140	KDSI (act) 70 60 40	E #3 (Norm Under (%) 0 0	RDSI (est) 70 60 40	140% DSIF MM (est) 182 7 155 4 101 5	PTK, NO UNDE TOEV (est) 18.1 17 14.5		MM (sct) 182 1 154 7 101 4	TDEV (act) 19.3 18.2 15.8	211		738
3 1 2	140 140 140 140	70 60 40 50	E#3 (Norm	70 60 40	140% DSIF MM (est) 1827 1554 1015 1283	PTK. NO UNDE TDEV (est) 18.1 17 14.5 15.8		MM (sci) 182 1 154 7 101 4 127 9	TDEV (act) 19.3 18.2 15.8 17.1	211		
3	140 140 140	KDSI (act) 70 60 40	E #3 (Norm Under (%) 0 0	RDSI (est) 70 60 40	140% DSIF MM (est) 182 7 155 4 101 5	PTK, NO UNDE TOEV (est) 18.1 17 14.5		MM (sct) 182 1 154 7 101 4	TDEV (act) 19.3 18.2 15.8	211		73.
3 1 2 5	140 140 140 140 140 KOSI (sct)	(KDS) (act) 70 60 40 50 80	E #3 (Norm Under (%) 0 0 0 0 0	MM(norm)	140% DSIF MM (est) 182 7 155 4 101 5 128 3 210 1	TOEV (est) 18.1 17 14.5 15.8 19.1	RSIZING))	MM (sct) 182 1 154 7 101 4 127 9 209 4	TDEV (act) 193 182 158 171 203	Coefficient	Productivity	
3 1 2 5	140 140 140 140 140 140 KOSI (act)	KDSI (act) 70 60 40 50 80 MM (est) 182.7	E#3 (Nom Under (%) 0 0 0 0 0 0	MAK(norm) 168 8	140% DSIF MM (est) 1827 1554 1015 1283 2101	PTK. NO UNDE TDEV (est) 18.1 17 14.5 15.8 19.1   MAI(norm)**O	ERSIZING))  Sum MM(nom)*Q 14686	MM (act) 182 1 154 7 101 4 127 9 209 4 Q*2 7569	TDEV (act) 19 3 18 2 15 8 17 1 20 3 sum Q*2 7589		Productivity 0 38	
3 1 2 5 Sensi 4 3	140 140 140 140 140 140 KOSI (act) 70	KDSI (act) 70 60 40 50 80 MM (est) 182.7	E #3 (Nom	MM(norm) 168 8 142.8	140% DSII MM (est) 1827 1554 1015 1283 2101	PTK. NO UNDE TDEV (est) 18.1 17.1 15.8 19.1 MM(norm)*Q 1486 10567	ERSIZING))  Sum MM(norm)*Q 14686 25253	MM (act) 182 1 154 7 101 4 127 9 209 4 Q^2 7569 5476	TDEV (act) 19.3 18.2 15.8 17.1 20.3 sum Q*2 75.69 13045		Productivity 0.38 0.39	
3 1 2 5 Sensi 4 3	140 140 140 140 140 (KDSI (act) 70 60 40	KDSI (act) 70 60 40 50 80  MM (est) 182.7 155.4	E#3 (Nom Under (%) 0 0 0 0 0 182.1 154.7	MM(norm) 168 8 142 8 92 7	140% DSIF MM (est) 182 7 155 4 101 5 128 3 210 1 Q 87 74 48	TOEV (est) 18.1 17 14.5 15.8 19.1  MM4(norm)**O 14686 19567 4450	sum MM(nom)*Q 14686 25253 29703	MM (act) 182 1 154 7 101 4 127 9 209 4 209 4 209 5476 2304	TDEV (act) 19 3 18 2 16 8 17 1 20 3 sum Q^2 7589 13045 15349		Productivity 0 38 0 39 0 39	
3 1 2 5 Sensi 4 3 1 2	140 140 140 140 140 (KOSI (act) 70 60 40	KDSI (act) 70 60 40 50 80 MM (est) 182.7 155.4 101.5	E#3 (Nom O 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	MM(norm) 168 8 142.8 92.7	140% DSII MM (est) 1827 1554 1015 128 3 210 1 Q 87 74 48 61	PTK. NO UNDE TDEV (est) 18.1 17 14.5 15.8 19.1   MM (norm)*Q 14686 10567 4450 7143	Sum MM(norm)*Q 14686 25253 29703 36846	MM (sci) 1821 154 7 101 4 127 9 209 4 QA2 7569 5476 2304 3721	TDEV (act) 19 3 18 2 15 8 17 1 20 3 sum Q*2 7569 13045 15049	Coefficient	Productivity 0 38 0 39 0 39 0 39	Comp Pr
3 1 2 5 Sensi 4 3	140 140 140 140 140 (KDSI (act) 70 60 40	KDSI (act) 70 60 40 50 80  MM (est) 182.7 155.4	E#3 (Nom Under (%) 0 0 0 0 0 182.1 154.7	MM(norm) 168 8 142 8 92 7	140% DSIF MM (est) 182 7 155 4 101 5 128 3 210 1 Q 87 74 48	TOEV (est) 18.1 17 14.5 15.8 19.1  MM4(norm)**O 14686 19567 4450	sum MM(nom)*Q 14686 25253 29703	MM (act) 182 1 154 7 101 4 127 9 209 4 209 4 209 5476 2304	TDEV (act) 19 3 18 2 16 8 17 1 20 3 sum Q^2 7589 13045 15349		Productivity 0 38 0 39 0 39	
3 1 2 5 Sensi 4 3 1 2	140 140 140 140 140 (KOSI (act) 70 60 40	KDSI (act) 70 60 40 50 80 MM (est) 182.7 155.4 101.5	E#3 (Nom O 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	MM(norm) 168 8 142.8 92.7	140% DSII MM (est) 1827 1554 1015 128 3 210 1 Q 87 74 48 61	PTK. NO UNDE TDEV (est) 18.1 17 14.5 15.8 19.1   MM (norm)*Q 14686 10567 4450 7143	Sum MM(norm)*Q 14686 25253 29703 36846	MM (sci) 1821 154 7 101 4 127 9 209 4 QA2 7569 5476 2304 3721	TDEV (act) 19 3 18 2 15 8 17 1 20 3 sum Q*2 7569 13045 15049	Coefficient	Productivity 0 38 0 39 0 39 0 39	Comp Pi
4 3 1 2 5 5 <b>Sense</b> 4 3 1 2 5	140 140 140 140 140 140 KOSI (sct) 70 60 40 50 80	KDSI (act) 70 60 40 50 80 MM (ext) 1827 1554 1015 128.3 210.1	E #3 (Norm Under (%) 0 0 0 0 0 1821 154 7 101 4 127 9 209 4	MM(norm) 168 8 142 8 92 7 195 6	140% DSII MM (est) 182 7 155 4 107 5 128 3 210 1 Q 87 74 48 61 100	PTK. NO UNDE TDEV (est) 18.1 17 14.5 15.8 19.1 14686 10567 4450 7143 19560	sum MM(norm)*Q 14686 25253 29703 36546 56406	MM (sci) 182 1 154 7 101 4 127 9 209.4 Q*2 27569 5476 2304 3721 10000	TDEV (act) 19 3 18 2 15 8 17 1 20.3 sum Q*2 7569 13045 15349 19070 29070	Coefficient	Productivity 0 38 0 39 0 39 0 39	Comp Pr
3 1 2 5 Sensi 4 3 1 2 5	140 140 140 140 140 140 KOSI (set) 70 60 40 50 80	KDSI (act)   70   70   70   60   60   40   50   80   80   152.7   155.4   101.5   128.3   210.1   CYCL   KDSI (act)   KD	E #3 (Nom Under (%) 0 0 0 0 0 1821 1821 1547 1014 127.9 209.4	Makized Data    KDSI (est)   70   60   40   50   80   168   8   142   8   92   7   117   1   195   6   195	140% DSII 182 7 182 7 155 4 101 5 128 3 210 1 Q 87 74 48 61 100 160% DSII	PTK. NO UNDE TOEV (est) 18.1 17. 14.5 15.8 19.1 MM4(norm)*Q 14686 10567 4450 7143 19560 PTK. NO UNDE	sum MM(norm)*Q 14686 25253 29703 36546 56406	MM (act) 182 1 154 7 101 4 127 9 209 4  2**2** 2**569 5476 3721 10000	TDEV (act) 19 3 18 2 16 8 17 1 20 3 sum Q*2 7569 13045 15349 19070 29070	Coefficient	Productivity 0 38 0 39 0 39 0 39	Comp Pr
4 3 1 2 5 5 Sensi 4 3 1 2 5 5	140 140 140 140 140 140 KOSI (æc!) 70 60 40 50 80	KDSI (act)   70   60   60   60   60   60   60   60	E #3 (Nom Under (%) 0 0 0 0 0 1821 1547 1014 127.9 2094	MAK(norm) 168 8 142.6 92 7 117 1 195 6  KDSI (est) 70 60 40 50 80  MAK(norm) 168 8 142.6 92 7 117 1 195 6	140% DSII MM (est) 182 4 101 5 128 3 210 1 87 74 48 61 100  160% DSII MM (est)	PTK. NO UNDE TDEV (est) 18.1 17. 14.5 15.8 19.1   MM(norm)**C 14686 10567 4450 7743 19560 PTK. NO UNDE TDEV (est) 17.5	sum MM(norm)*Q 14686 25253 29703 36546 56406	MM (act) 182 1 154 7 101 4 127 9 209 4  272 7569 5476 2304 3721 10000	TDEV (act) 19 3 18 2 15 8 17 1 20 3 sum Q*2 7569 13045 15349 19070 29070	Coefficient	Productivity 0 38 0 39 0 39 0 39	Comp Pr
3 1 2 5 1 Sensi 4 3 1 2 5	140 140 140 140 140 140 KOSI (sct) 70 60 40 50 80	KDSI (act)	E #3 (Norm Under (%) 0 0 0 0 0 1821 1547 1014 1279 2094	MAX(norm) 168 8 142 8 92 7 195 6  Max(com) 168 8 142 8 92 7 195 6  Max(com) 195 6	140% DSII MM (est) 182 7 155 4 107 5 128 3 210 1 Q 87 74 48 61 100 160% DSII MM (est) 167 9 93 3	PTK. NO UNDE TDEV (est) 18.1 17. 14.5 15.8 10567 44.50 10567 44.50 7143 19560 PTK. NO UNDE TDEV (est) 17.5 14.	sum MM(norm)*Q 14686 25253 29703 36546 56406	MM (sci) 182 1 154 7 101 4 127 9 209.4	TDEV (act) 19.3 18.2 15.6 17.1 20.3 sum Q*2 7569 13045 15349 19070 29070	Coefficient	Productivity 0 38 0 39 0 39 0 39	Comp Pr
3 1 2 5 5 Sensi 4 3 1 2 5 5	140 140 140 140 140 140 KOSI (æc!) 70 60 40 50 80	KDSI (act)   70   60   60   60   60   60   60   60	E #3 (Nom Under (%) 0 0 0 0 0 1821 1547 1014 127.9 2094	MAK(norm) 168 8 142.6 92 7 117 1 195 6  KDSI (est)	140% DSII MM (est) 182 4 101 5 128 3 210 1 87 74 48 61 100  160% DSII MM (est)	PTK. NO UNDE TDEV (est) 18.1 17. 14.5 15.8 19.1   MM(norm)**C 14686 10567 4450 7743 19560 PTK. NO UNDE TDEV (est) 17.5	sum MM(norm)*Q 14686 25253 29703 36546 56406	MM (act) 182 1 154 7 101 4 127 9 209 4  272 7569 5476 2304 3721 10000	TDEV (act) 19 3 18 2 15 8 17 1 20 3 sum Q*2 7569 13045 15349 19070 29070	Coefficient	Productivity 0 38 0 39 0 39 0 39	Comp Pr
3 1 2 5   Sensi 4 3 1 2 5	140 140 140 140 140 140 KOSI (ect) 70 60 40 50 80 80	KDSI (act)   70   70   70   60   60   80   80   80   80   80   8	E #3 (Nom Under (%) 0 0 0 0 0 0 1821 1547 1014 127.9 2094	MACOOM 1956  MACOOM 1956  MACOOM 1958  MACOOM 1958  MACOOM 1956  MACOO	140% DSII MM (est) 182 7 155 4 101 5 128 3 210 1 2 87 74 48 61 100 160% DSII 167 9 93 3 193 2	PTK. NO UNDE TÜEV (est) 18.1 17. 14.5 15.8 19.1 MM4(norm)*Q. 14886 10567 4450 7143 19560 PTK. NO UNDE TÜEV (est) 17.5 14.5 14.5 15.8 17.7 18.7 19.7	sum MM(norm)*Q 14686 25253 29703 36546 56406	MM (act) 182 1 154 7 101 4 127 9 209 4 7569 5476 2304 3721 10000 MM (act) 167 5 93 1 192 7 192 7	TDEV (act) 19 3 18 2 16 8 17 1 20 3 sum Q-2 7589 13045 19070 29070	Coefficient	Productivity 0 38 0 39 0 39 0 39	Comp Pr
4 3 1 2 5 4 3 1 2 5 5 Sensel 4 1 5 5	140 140 140 140 140 140 KOSI (set) 70 60 40 50 80 80 160 160 160 160	KDSI (act)   70   60   60   60   60   70   60   60	E #3 (Nom  Under (%) 0 0 0 0 0 1821 1547 1014 127.9 2094  E#4 (Nom  Under (%) 0 0 0	MM(norm) 168 8 142.8 92.7 117.1 195.6  KDSI (est) 70 60 40 50 80 MM(norm) 168 8 142.8 92.7 117.1 195.6	140% DSII MM (est) 182 7 155 4 101 5 128.3 210 1 60 87 74 48 61 100  160% DSII MM (est) 167 9 93.3 118 142 8	PTK. NO UNDE TÜEV (est) 18.1 17. 14.5 15.8 19.1   MM/(norm)**Q 14886 10567 4450 7143 19560 PTK. NO UNDE TDEV (est) 17.5 14. 18.5 19.5 19.5 10.	sum MM(norm)*Q 14686 25253 29703 36846 56406	MM (act) 182 1 154 7 101 4 127 9 209 4 3721 10000 MM (act) 167 5 93 1 192 7 117 7 142 3	TDEV (act) 19 3 18 2 15 8 17 1 20 3 sum G*2 7589 13045 15349 19070 29070 TDEV (act) 18 7 15 4 19 7 16 6 17 7	Coefficient	Productivity 0 38 0 39 0 39 0 38	0 387
4 3 1 2 5 <b>Sense</b> 4 3 1 2 5 5	140 140 140 140 140 140 140 140 160 160 160 160 KOSI (sec)	KDS1 (act)   70   60   60   60   60   60   60   60	E #3 (Norm (%) 0 0 0 0 0 0 0 182 1 154 7 101 4 127 9 209 4   E #4 (Norm Under (%) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	MAC(norm)  KDSI (est)  70  60  40  50  80  MAC(norm)  168 8  142.8  92.7  117.1  195.6  KDSI (est)  70  40  80  60  MAK(norm)	140% DSII MM (est) 182 7 155 4 101 5 128 3 210 1 Q 87 74 48 61 100 160% DSII MM (est) 167 9 93 3 193 2 118 142 8	PTK. NO UNDE TDEV (est) 18.1 17. 14.5 15.8 19.1 14.686 10567 4450 7143 19560 PTK. NO UNDE TDEV (est) 17.5 14. 18.5 15.3 16.5 MM/(norm)*Q	Sum MM(norm)*Q 14686 25253 29703 36846 56406	MM (sci) 182 1 154 7 101 4 127 9 209.4  Q*2 7569 5476 2304 3721 10000  MM/ (sci) 167.5 93 1 192.7 117 7 142.3	TDEV (act) 19 3 18 2 15 8 17 1 20 3 sum Q*2 7569 13045 15349 19070 29070 TDEV (act) 18 7 15 4 19 7 15 6 17 7	Coefficient	Productivity 0.39 0.39 0.39 0.38	0 387
4 3 1 2 5 5 9 Sensel 4 3 3 1 2 5 5 5 5 9 Sensel 4 3 3 1 2 5 5 5 5 5 7 8 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9	140 140 140 140 140 140 KOSI (sct) 60 40 50 80 DSIPTK (% 160 160 160 160 160	KDSI (act)   FO   FO   FO   FO   FO   FO   FO   F	E #3 (Nom Under (%) 0 0 0 0 0 182 1 154 7 101 4 127 9 209 4  E #4 (Nom Under (%) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	MAN(norm)  AMA(norm)	140% DSII MM (est) 182 7 155 4 101 5 128 3 210 1 Q 87 74 48 61 100  160% DSII MM (est) 167 9 193 2 118 1428 Q 87	PTK. NO UNDE TÜEV (est) 18.1 17. 14.5 15.8 19.1 MM(norm)*Q 14686 10567 4450 7143 19560 PTK. NO UNDE TDEV (est) 17.5 14.5 15.8	sum MM(nom)*Q 14686 25253 29703 36546 56406  FRSIZING))	MM (act) 182 1 154 7 101 4 127 9 209 4  209 4  2304 3721 10000  MM (act) 167 5 192 7 117 7 142 3  27 569	TDEV (act) 19 3 18 2 16 8 17 1 20 3 sum Q-2 7589 13045 13045 19070 29070 TDEV (act) 18 7 15 4 19 7 16 6 17 7 sum Q-2 7589	Coefficient	Productivity 0 38 0 39 0 39 0 39 0 38	0 387
4 3 1 2 5 5 9 Sensi 4 4 3 1 2 2 5 5 5 9 Sensi 4 4 4 1 5 5 2 3 3 3 9 Sensi 4 4 4 4 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	140 140 140 140 140 140 140  KOSI (æci) 70 60 40 50 80  DSIPTK (%) 160 160 160 160 160 160 160 160 40	KDSI (act)   70   60   40   50   60   60   60   60   60   60   6	E #3 (Norm  Under (%) 0 0 0 0 0 1821 1547 1014 127.9 2094  E #4 (Norm Under (%) 0 0 0 0 0 MM/(act) 167.5	MAK(norm) 150 40 50 40 50 80 MM(norm) 168 8 142.8 92 7 117 1 195 6  KDSI (est) 70 40 60 50 60 MM(norm) 157 86 4	140% DSII MM (est) 182 4 101 5 128 3 210 1 0 87 74 48 61 100 160% DSII MM (est) 1679 933 2 118 142 8 87	PTK. NO UNDE TÜEV (est) 18.1 17. 14.5 15.8 19.1   MM/(norm)*Q 14886 10567 4450 7143 19560 PTK. NO UNDE TDEV (est) 17.5 14. 18.5 15.3 16.5 16.5 16.5 16.5 17.5 14.5 16.5	sum MM(norm)*Q 14686 25253 29703 36846 56406  ERSIZING))  sum MM(norm)*Q 11859 17806	MM (act) 182 1 154 7 101 4 127 9 209 4 7569 5476 2304 3721 10000  MM (act) 167.5 93 1 192.7 117 7 142 3  \$\frac{1}{2}\$ \$\frac{1}{2}\$\$ \$	TDEV (act) 19 3 18 2 15 8 17 1 20 3 sum Q^2 7569 13045 15049 19070 29070 TDEV (act) 18 7 16 6 17 7 sum Q^2 7569	Coefficient	Productivity 0 38 0 39 0 39 0 38 0 38	0 387
4 3 1 2 5 5 Sernal 4 3 1 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	140 140 140 140 140 140 KOSI (sct) 60 40 50 80 DSIPTK (% 160 160 160 160 160	KDSI (act)   FO   FO   FO   FO   FO   FO   FO   F	E #3 (Nom Under (%) 0 0 0 0 0 182 1 154 7 101 4 127 9 209 4  E #4 (Nom Under (%) 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	MAN(norm)  AMA(norm)	140% DSII MM (est) 182 7 155 4 101 5 128 3 210 1 Q 87 74 48 61 100  160% DSII MM (est) 167 9 193 2 118 1428 Q 87	PTK. NO UNDE TÜEV (est) 18.1 17. 14.5 15.8 19.1 MM(norm)*Q 14686 10567 4450 7143 19560 PTK. NO UNDE TDEV (est) 17.5 14.5 15.8	sum MM(nom)*Q 14686 25253 29703 36546 56406  FRSIZING))	MM (act) 182 1 154 7 101 4 127 9 209 4  209 4  2304 3721 10000  MM (act) 167 5 192 7 117 7 142 3  27 569	TDEV (act) 19 3 18 2 16 8 17 1 20 3 sum Q-2 7589 13045 13045 19070 29070 TDEV (act) 18 7 15 4 19 7 16 6 17 7 sum Q-2 7589	Coefficient	Productivity 0 38 0 39 0 39 0 39 0 38	0 387

		CYCL	E#5 (Norm	natized Data	180% OSIP	TK, NO UNDE	RSIZING))					
Proj Sensi	DSPTK (%)	KOSI (act)	Under (%)	KDSI (est)	NW (est)	TDEV (est)		MM (act)	TDEV (act)			
5	180	80	. 0	. 80	180 3	18		179 6	19.2			
4	180	70	. 0	70	156 7	17 1_		156 t	183			
2	180	50	0	50	1101	149_		109 6	16 2			
3	180	60	0	60	133 3	16	-	133	17 3			
1	180	40	0	40	87 1	13.7		86 7	15 1			
Proj Sensi	KQSI (act)	MM (est)	MM(act)	MM(norm)	٥	MM(norm)*Q	sum MM(narm)*Q	Q*2	sum Q*2	Coefficient	Productivity	Comp Prod
5	80	180 3	179 6	171.3	100	17130	17130	10000	10000		0 45	
4	70	156 7	156 1	147 6	87	12841	29971	7569	17569		0 45	
2	50	110 1	109.6	102 5	61	6253	36224	3721	21290		0 46	
3	60	133 3	133	124 4	74	9206	45430	5476	29766		0 45	
1	40	87 1	86 7	80 7	48	3874	49304	2304	29070	17	0.46	0 451
		c.A.c.r	E#6 (Norm	nelized Data	200% DSIP	TK. NO UNDE	RSIZING))					
Proj Senal	DSIPTK (%)	CYCL Kosi (ad)	E#6 (Norm	skized Data	200% DSIP	TDEV (est)	RSIŽING))		TDEV (aci)			
Proj Senal	DSIP1K (%)	CYCL RDSI (act)	E #6 (Norm	nskzed Data KDSI (est) 40	200% DSIP MM (est) 518	10EV (est) 13.3	ersizing))	81 4	14.7			
2	OSIPTR (%) 200 200	CYCL KDSi (ad) 40 50	E #6 (Norm	Mikzed Data KDSI (est) 40 50	200% DSIP MM (est) 518 1034	10EV (est) 13 3 14 6	RSIZING))	81 4 103	14.7			
Proj Senal	200 200 200 200	CYCL KDSi (act) 40 50	E #6 (Norm	Mikzed Data KDSI (est) 40 50 60	200% DSIP MM (est) 81 8 103 4 125 2	10EV (est) 13 3 14 6 15 7	RSIŽING))	81 4 103 124 7	14.7 15.9 16.9			
1 2	DSIPTK (%) 200 200 200 200	CYCL KDSi (act) 40 50 60 70	E #6 (Norm Under (%) 0 0 0	Moderate Data  KDSI (est)  40  50  60  70	200% DSIP MM (est) 81 8 103 4 125 2 147 2	13 3 14 6 15 7 16 7	RSIZING))	81 4 103 124 7 146 8	147 159 169 179			
1 2	200 200 200 200	CYCL KDSi (act) 40 50	E #6 (Norm	Mikzed Data KDSI (est) 40 50 60	200% DSIP MM (est) 81 8 103 4 125 2	10EV (est) 13 3 14 6 15 7	ERSIZING))	81 4 103 124 7	14.7 15.9 16.9			
1 2 3 4 5	DSIPTK (%) 200 200 200 200	CYCL KDSI (act) 40 50 60 70 80	Under (%) 0 0 0 0 0 0 0 0	Moderate Data  KDSI (est)  40  50  60  70	200% DSIP MM (est) 81 8 103 4 125 2 147 2 169 3	10EV (est) 13 3 14 6 15 7 16 7 17 6	RSIZING))	81 4 103 124 7 146 8 168 5	14 7 15 9 16 9 17 9 18 8		Productivity	Ccmp Prod
1 2 3 4 5	DSIPTK (%)   200   200   200   200   200   KD\$I (ed)	CYCL KDSI (act) 40 50 60 70 80	E \$6 (Norm Under (%) 0 0 0 0 0 0 MM(sct) 814	MM(norm)	200% DSIP MM (est) 51 8 103 4 125 2 147 2 169 3	TDEV (est) 13.3 14.6 15.7 16.7 17.6	sum MM(nom)*Q	81 4 103 124 7 146 8 168 5	14 7 15 9 16 9 17 9 18 8 sum Q*2 2304		0 49	Comp Prod
1 2 3 4 5	DSIPTK (%) 200 200 200 200 200 200 KDSI (act) 40 50	CYCLI KDSI (act) 40 50 60 70 80 MM (est) 81 8 103.4	E \$6 (Norm Under (%) 0 0 0 0 0 MM(sct) 814 103	MA(norm)	200% DSIP MM (est) 81 8 103 4 125 2 147 2 169 3	TDEV (est) 13 3 14 6 15 7 16 7 17 6	sum MM(norm)*Q 0 0	81 4 103 124 7 146 8 168 5 0^2 2304 3721	14 7 15 9 16 9 17 9 18 8 sum Q*2 2304 6025		0 49 0 49	Comp Prod
1 2 3 4 5	DSIPTK (%)   200   200   200   200   200   KD\$1 (set)   40   50	CYCLI KDSi (act) 40 50 60 70 80 MM (est) 81 8 103 4 125 2	E #6 (Norm Under (%) 0 0 0 0 0 1 0 103 124 7	MAK(norm)	200% DSIP MM (est) 818 1034 1252 1472 1693 Q 48 61 74	10EV (est) 13 3 14 6 15 7 16 7 17 6	sum MM/(norm)*Q 0 0 0	81 4 103 124 7 146 8 168 5 0^2 2304 3721 5476	14 7 15 9 16 9 17 9 18 8 sum Q*2 2304 6025 11501		0 49 0 49 0 48	Comp Prod
1 2 3 4 5	DSIPTK (%) 200 200 200 200 200 200 KDSI (act) 40 50	CYCLI KDSI (act) 40 50 60 70 80 MM (est) 81 8 103.4	E \$6 (Norm Under (%) 0 0 0 0 0 MM(sct) 814 103	MA(norm)	200% DSIP MM (est) 81 8 103 4 125 2 147 2 169 3	TDEV (est) 13 3 14 6 15 7 16 7 17 6	sum MM(norm)*Q 0 0	81 4 103 124 7 146 8 168 5 0^2 2304 3721	14 7 15 9 16 9 17 9 18 8 sum Q*2 2304 6025		0 49 0 49	Ccmp Prod

### APPENDIX F. NORMALIZATION DATA LEARNING - NO UNDERSIZING

C	YCLE #1,	PROJECT	*#1	c	YCLE #1,	PROJECT	#2
KDSI (est)	TDEV (est)	MM (est)	MM (act)	KDSI (est)	TDEV (est)	MM (est)	MM (act)
40	16.5	115.4	115.3	50	17.9	145.9	146.4
40	16.5	110	114.2	50	17.9	135	144.1
40	16.5	105	114	50	17.9	125	143.1
40	16.5	100	112.9	50	17.9	120	142.6
40	16.5	95	112.8	50	17.9	115	142.4
40	16.5	90	112.9	50	17.9	110	143.1
40	16.5	85	112.9	50	17.9	105	143.5
40	16.5	80	113.6				,
C	YCLE #1,	PROJECT	#3	С	YCLE #1, 1	PROJECT	#4
KDSI (est)	TDEV (est)	MM (est)	MM (act)	KDSI (est)	TDEV (est)	MM (est)	MM (act)
60	19.9	178.3	178.8	70	20.7	212	212.5
60	19.9	155	173.2	70	20.7	190	205.9
60	19.9	150	173	70	20.7	180	204.5
60	19.9	145	172.8	70	20.7	175	204.3
60	19.9	140	173.4	70	20.7	170	204.6
60	19.9	135	174.3	70	20.7	165	205.3
	<del>'</del>			70	20.7	160	205.8
	YCLE #1,	PROJECT	#5		YCLE #2, I	PROJECT	#2
	YCLE #1,		#5		YCLE #2, I		MM (act)
	TDEV (est) 21.9	MM (est) 246.7	MM (act) 247.8	KDSI (est) 50	TDEV (est) 17.7		المناسبين المسا
KDSI (est) 80 80	TDEV (est) 21.9 21.9	MM (est) 246.7 220	MM (act) 247.8 237.8	KDSI (est) 50 50	TDEV (est) 17.7 17.7	MM (est) 142.4 130	MM (act) 142.1 131.2
KDSI (est) 80 80 80	TDEV (est) 21.9 21.9 21.9	MM (est) 246.7 220 215	MM (act) 247.8 237.8 236.9	KDSI (est) 50 50 50	17.7 17.7 17.7	MM (est) 142.4 130 120	MM (act) 142.1 131.2 130.3
KDSI (est) 80 80 80 80	TDEV (est) 21.9 21.9 21.9 21.9	MM (est) 246.7 220 215 210	MM (act) 247.8 237.8 236.9 236.5	KDSI (est) 50 50 50 50	17.7 17.7 17.7 17.7 17.7	MM (est) 142.4 130 120 115	MM (act) 142.1 131.2 130.3 128.9
KDSI (est) 80 80 80 80 80 80	TDEV (est) 21.9 21.9 21.9 21.9 21.9	MM (est) 246.7 220 215 210 205	MM (act) 247.8 237.8 236.9 236.5 236.7	KDSI (est) 50 50 50 50 50	17.7 17.7 17.7 17.7 17.7 17.7	MM (est) 142.4 130 120 115 110	MM (act) 142.1 131.2 130.3 128.9 128.2
KDSI (est) 80 80 80 80 80 80	TDEV (est) 21.9 21.9 21.9 21.9 21.9 21.9 21.9	MM (est) 246.7 220 215 210 205 200	MM (act) 247.8 237.8 236.9 236.5 236.7 237	KDSI (est) 50 50 50 50 50 50 50	TDEV (est) 17.7 17.7 17.7 17.7 17.7 17.7	MM (est) 142.4 130 120 115 110 105	MM (act) 142.1 131.2 130.3 128.9 128.2 128.2
KDSI (est) 80 80 80 80 80 80 80	TDEV (est) 21.9 21.9 21.9 21.9 21.9 21.9 21.9 21.9	MM (est) 246.7 220 215 210 205 200 195	MM (act) 247.8 237.8 236.9 236.5 236.7 237 237.8	KDSI (est) 50 50 50 50 50 50 50 50 50	TDEV (est) 17.7 17.7 17.7 17.7 17.7 17.7	MM (est) 142.4 130 120 115 110 105 102.5	MM (act) 142.1 131.2 130.3 128.9 128.2 128.2 127.9
KDSI (est) 80 80 80 80 80 80	TDEV (est) 21.9 21.9 21.9 21.9 21.9 21.9 21.9	MM (est) 246.7 220 215 210 205 200	MM (act) 247.8 237.8 236.9 236.5 236.7 237	KDSI (est) 50 50 50 50 50 50 50 50 50 50 50	TDEV (est) 17.7 17.7 17.7 17.7 17.7 17.7 17.7 17.	MM (est) 142.4 130 120 115 110 105 102.5 100	MM (act) 142.1 131.2 130.3 128.9 128.2 128.2
KDSI (est) 80 80 80 80 80 80 80	TDEV (est) 21.9 21.9 21.9 21.9 21.9 21.9 21.9 21.9	MM (est) 246.7 220 215 210 205 200 195	MM (act) 247.8 237.8 236.9 236.5 236.7 237 237.8	KDSI (est) 50 50 50 50 50 50 50 50 50	TDEV (est) 17.7 17.7 17.7 17.7 17.7 17.7	MM (est) 142.4 130 120 115 110 105 102.5	MM (act) 142.1 131.2 130.3 128.9 128.2 128.2 127.9
KDSI (est) 80 80 80 80 80 80 80 80	TDEV (est) 21.9 21.9 21.9 21.9 21.9 21.9 21.9 21.9	MM (est) 246.7 220 215 210 205 200 195 190	MM (act) 247.8 237.8 236.9 236.5 236.7 237 237.8 238.6	KDSI (est) 50 50 50 50 50 50 50 50 50 50 50 50 50	TDEV (est) 17.7 17.7 17.7 17.7 17.7 17.7 17.7 17.	MM (est) 142.4 130 120 115 110 105 102.5 100 95	MM (act) 142.1 131.2 130.3 128.9 128.2 128.2 127.9 128.5
KDSI (est) 80 80 80 80 80 80 80 80 80	TDEV (est) 21.9 21.9 21.9 21.9 21.9 21.9 21.9 21.9	MM (est) 246.7 220 215 210 205 200 195 190 PROJECT	MM (act) 247.8 237.8 236.9 236.5 236.7 237 237 237.8 238.6	KDSI (est) 50 50 50 50 50 50 50 50 50 50 50 60 60 60 60 60 60 60 60 60 60 60 60 60	TDEV (est) 17.7 17.7 17.7 17.7 17.7 17.7 17.7 17.	MM (est) 142.4 130 120 115 110 105 102.5 100 95	MM (act) 142.1 131.2 130.3 128.9 128.2 128.2 127.9 128.5
KDSI (est) 80 80 80 80 80 80 80 80 80	TDEV (est) 21.9 21.9 21.9 21.9 21.9 21.9 21.9 21.9	MM (est) 246.7 220 215 210 205 200 195 190 PROJECT	MM (act) 247.8 237.8 236.9 236.5 236.7 237 237.8 238.6	KDSI (est) 50 50 50 50 50 50 50 50 50 50 60 60 60 60 60 60 60 60 60 60 60 60 60	TDEV (est) 17.7 17.7 17.7 17.7 17.7 17.7 17.7 17.	MM (est) 142.4 130 120 115 110 105 102.5 100 95  PROJECT MM (est)	MM (act) 142.1 131.2 130.3 128.9 128.2 127.9 128.5
KDSI (est) 80 80 80 80 80 80 80 80 KDSI (est)	TDEV (est) 21.9 21.9 21.9 21.9 21.9 21.9 21.9 21.9	MM (est) 246.7 220 215 210 205 200 195 190 PROJECT MM (est)	MM (act) 247.8 237.8 236.9 236.5 236.7 237 237 237.8 238.6	KDSI (est) 50 50 50 50 50 50 50 50 50 50 50 60 60 60 60 60 60 60 60 60 60 60 60 60	TDEV (est) 17.7 17.7 17.7 17.7 17.7 17.7 17.7 17.	MM (est) 142.4 130 120 115 110 105 102.5 100 95	MM (act) 142.1 131.2 130.3 128.9 128.2 128.2 127.9 128.5
KDSI (est) 80 80 80 80 80 80 80 80 KDSI (est)	TDEV (est) 21.9 21.9 21.9 21.9 21.9 21.9 21.9 21.9	MM (est) 246.7 220 215 210 205 200 195 190  PROJECT MM (est) 112.6	MM (act) 247.8 237.8 236.9 236.5 236.7 237 237.8 238.6  #1  MM (act) 112.2 102.9 102.1	KDSI (est) 50 50 50 50 50 50 50 50 50 50 60 60	TDEV (est) 17.7 17.7 17.7 17.7 17.7 17.7 17.7 17.	MM (est) 142.4 130 120 115 110 105 102.5 100 95 PROJECT MM (est) 172.6 150	MM (act) 142.1 131.2 130.3 128.9 128.2 128.2 127.9 128.5 #3 MM (act) 172.3 159.4
KDSI (est) 80 80 80 80 80 80 80 80 80 KDSI (est)	TDEV (est) 21.9 21.9 21.9 21.9 21.9 21.9 21.9 21.9	MM (est) 246.7 220 215 210 205 200 195 190  PROJECT MM (est) 112.6 100	MM (act) 247.8 237.8 236.9 236.5 236.7 237 237 237.8 238.6  #1  MM (act) 112.2 102.9	KDSI (est) 50 50 50 50 50 50 50 50 50 50 60 CC	TDEV (est) 17.7 17.7 17.7 17.7 17.7 17.7 17.7 17.	MM (est) 142.4 130 120 115 110 105 102.5 100 95 PROJECT MM (est) 172.6 150 135	MM (act) 142.1 131.2 130.3 128.9 128.2 128.2 127.9 128.5 #3 MM (act) 172.3 159.4 156
KDSI (est) 80 80 80 80 80 80 80 80 80 KDSI (est)	TDEV (est) 21.9 21.9 21.9 21.9 21.9 21.9 21.9 21.9	MM (est) 246.7 220 215 210 205 200 195 190 PROJECT MM (est) 112.6 100 90	MM (act) 247.8 237.8 236.9 236.5 236.7 237 237.8 238.6  #1  MM (act) 112.2 102.9 102.1	KDSI (est) 50 50 50 50 50 50 50 50 50 50 60 60 60	TDEV (est) 17.7 17.7 17.7 17.7 17.7 17.7 17.7 17.	MM (est) 142.4 130 120 115 110 105 102.5 100 95 PROJECT MM (est) 172.6 150 135 132.5	MM (act) 142.1 131.2 130.3 128.9 128.2 127.9 128.5  #3  MM (act) 172.3 159.4 156 155.6
KDSI (est) 80 80 80 80 80 80 80 80 80 KDSI (est) 40 40 40	TDEV (est) 21.9 21.9 21.9 21.9 21.9 21.9 21.9 21.9	MM (est) 246.7 220 215 210 205 200 195 190  PROJECT MM (est) 112.6 100 90 85	MM (act) 247.8 237.8 236.9 236.5 236.7 237 237.8 238.6  #1  MM (act) 112.2 102.9 102.1 101.6	KDSI (est) 50 50 50 50 50 50 50 50 50 50 50 60 60 60	TDEV (est) 17.7 17.7 17.7 17.7 17.7 17.7 17.7 17.	MM (est) 142.4 130 120 115 110 105 102.5 100 95 PROJECT MM (est) 172.6 150 135	MM (act) 142.1 131.2 130.3 128.9 128.2 128.2 127.9 128.5 #3 MM (act) 172.3 159.4 156
KDSI (est) 80 80 80 80 80 80 80 80 80 80 80 40 40 40 40	TDEV (est) 21.9 21.9 21.9 21.9 21.9 21.9 21.9 21.9	MM (est) 246.7 220 215 210 205 200 195 190  PROJECT MM (est) 112.6 100 90 85 80	MM (act) 247.8 237.8 236.9 236.5 236.7 237 237.8 238.6  #1  MM (act) 112.2 102.9 102.1 101.6 101.2	KDSI (est) 50 50 50 50 50 50 50 50 50 50 60 60 60 60 60	TDEV (est) 17.7 17.7 17.7 17.7 17.7 17.7 17.7 17.	MM (est) 142.4 130 120 115 110 105 102.5 100 95 PROJECT MM (est) 172.6 135 132.5 130 127.5 125	MM (act) 142.1 131.2 130.3 128.9 128.2 128.2 127.9 128.5  #3  MM (act) 172.3 159.4 156 155.6
KDSI (est) 80 80 80 80 80 80 80 80 80 80 40 40 40 40 40	TDEV (est) 21.9 21.9 21.9 21.9 21.9 21.9 21.9 21.9	MM (est) 246.7 220 215 210 205 200 195 190  PROJECT MM (est) 112.6 100 90 85 80 75	MM (act) 247.8 237.8 236.9 236.5 236.7 237 237.8 238.6  #1  MM (act) 112.2 102.9 102.1 101.6 101.2 101.9	KDSI (est) 50 50 50 50 50 50 50 50 50 50 60 60 60 60 60	TDEV (est) 17.7 17.7 17.7 17.7 17.7 17.7 17.7 17.	MM (est) 142.4 130 120 115 110 105 102.5 100 95 PROJECT MM (est) 172.6 150 135 130 127.5	MM (act) 142.1 131.2 130.3 128.9 128.2 128.2 127.9 128.5  #3  MM (act) 172.3 159.4 156 155.6 155.6

С	YCLE #2, F	PROJECT	#5	C)	/CLE #2, F	PROJECT	#4
KDSI (est)	TDEV (est)	MM (est)	MM (act)	KDSI (est)	TDEV (est)	MM (est)	MM (act
80	21.2	233.7	232.9	70	20.1	203.1	202.4
80	21.2	210	218.5	70	20.1	180	188.3
80	21.2	190	213.6	70	20.1	160	184.4
80	21.2	185	213	70	20.1	155	183.9
80	21.2	180	212.9	70	20.1	150	184.5
80	21.2	177.5	213.5	70	20.1	145	185.6
80	21.2	175	213.4				·
80	21.2	170	215.3				
	VOLE 40	DDO IFOT	#4		VOLE #2.1	DOO ITOT	40
	YCLE #3, I					PROJECT	
	TDEV (est)		MM (act)	KUSI (est)	TDEV (est)	MM (est) 154.7	MM (act 154.2
70 70	19.3	182.1	181.6 172.6	60	18.2	135	146.4
70 70	19.3 19.3	160 145	169.1	60	18.2 18.2	135	143.8
70			168.8	60	18.2	120	142.8
70	19.3 19.3	142.5 140	169.1	60	18.2	115	142.9
			10017	60		110	142.9
70 70	19.3 19.3	135 130	169.7 170.9	60	18.2 18.2	105	145.6
С	YCLE #3, F	ROJECT	#1	C)	YCLE #3, I	PROJECT	#2
KDSI (est)	TDEV (est)	MM (est)	MM (act)		TDEV (est)	MM (est)	MM (act
40	15.8	101.4	101.1	50	17.1	127.9	127.4
40	15.8	90	94.4	50	17.1	100	118.1
40	15.8	80	93.4	50	17.1	95	117.5
40	15.8	75	93.1	50	17.1	92.5	117.1
40	15.8	70	92.7	50	17.1	90	117.9
40	15.8	65	93.9	50	17.1	85	119.8
40	15.8	60	97	50	17.1	80	122.4
	YCLE #3, 1					PROJECT	
	TDEV (est)		MM (act)		TDEV (est)		MM (act
80	20.3	209.4	208.8	70	18.7	167.5	167.2
80	20.3	180	197.9	70	18.7	150	161.6
80 80	20.3	170	195.7	70	18.7	135	157.8
CNI	20.3	167.5	195.7	70 70	18.7	132.5	157.4
			TUNK I	1 7()	18.7	130	157
80	20.3	165	195.6				
80 80	20.3	160	196.1	70	18.7	127.5	157.3
80 80 80	20.3 20.3	160 155	196.1 197.3				157.3
80 80	20.3	160	196.1	70	18.7	127.5	

CYCLE #4, PROJECT #1										
KUŞI (est)	TOEV (est)	MMI (est)	MM (act)							
40	15.4	93.1	92.9							
40	15.4	80	88							
40	15 4	75	88.1							
40	15.4	70	86.5							
40	15.4	65	86.4							
40	15.4	60	86.9							

KDSI (est	TDEV (est)	MM (est)	MM (act)
80	19.7	192.7	191.9
80	19.7	170	185.5
80	19.7	160	183.1
80	19.7	155	182.2
80	19.7	150	182.5
80	19.7	145	182.9
80	19.7	140	184.7

C	YCLE #4, F	PROJECT	#2	 C	YCLE #4, F	PROJECT	#3
KDSI (est)	TDEV (est)	MM (est)	MM (act)	 KDSI (est)	TDEV (est)	MM (est)	MM (act)
50	16.6	117.7	117.4	 60	17.7	142.3	142
50	16.6	100	112.3	60	17.7	120	135.3
50	16.6	90	109.8	60	17.7	110	133
50	16.6	87.5	109.4	60	17.7	107.5	133
50	16.6	85	109	60	17.7	105	132.9
50	16.6	82.5	109.7	· 60	17.7	102.5	133.4
50	16.6	80	109.9	60	17.7	100	134
	·		•	60	17.7	80	142.2
					;		

C	YCLE #5, F	PROJECT	#5		C	YCLE #5, F	PROJECT	#4
KDSI (est)	TDEV (est)	MM (est)	MM (act)	<del></del>	KDSI (est)	TDEV (est)	MM (est)	MM (act)
80	19.2	179.6	179		70	18.3	156.1	155.6
80	19.2	160	174.8		70	18.3	140	151.4
80	19.2	150	172.2		70	18.3	125	148.5
80	19.2	145	171.8		70	18.3	120	147.6
80	19.2	140	171.3		70	18.3	115	148.6
80	19.2	135	171.6			-		1
80	19.2	130	173.2					i i

С	YCLE #5, F	PROJECT	#2	С	YCLE #5, F	PROJECT	#3
KDSI (est)	TDEV (est)	MM (est)	MM (act)	KDSI (est)	TDEV (est)	MM (est)	MM (act)
50	16.2	109.6	109.1	60	17.3	133	132.6
50	16.2	90	104.6	60	17.3	120	129.3
50	16.2	85	103.5	60	17.3	110	126.6
50	16.2	80	102.5	60	17.3	105	126
50	16.2	75	103.3	60	17.3	100	125.1
50	16.2	70	105.5	60	17.3	97.5	124.4
				60	17.3	95	125.1

(DSI (est)	TDEV (est)	MA (est)	VM (act)
40	15.1	86.7	86 4
40	15.1	70	83 4
40	15 1	65	81 6
40	15.1	62.5	81
40	15.1	60	80.7
40	15.1	57 5	80.8
4C	15.1	55	82.2

### APPENDIX G. CONVENTIONAL CALIBRATION STRATEGY: UNDERSIZING - NO LEARNING

1				CYCLE	H(Rew Date	)					
Pro Sala	PSPK(6)	(08 (68)	Under (%)	(03/(-1)		TUEV (est)		MM (act)	TOEV (ed)	<u> </u>	
	100	40	40	24	67.5	12.4		120.9	18.5		<del></del>
2	100	50	20	40	115.4	15.2		149.7	18.6		<del>-</del>
3	100	60 70	30 50	35	121.5	15.5 14.4		187.6 245.8	19.9 21.9	<b></b>	
1 - 5 -	100	80	10	72	214	19.2		242.3	22.3	<del></del>	
										ļ	
Pro Seriel	KUS (ac)	MM (est)	(Allect)	Q		BUTH MANAGET Q	C/-2	sum Q <sup>2</sup> 2	Coefficient		Comp Prod
1 2	50	115.4	120.9 149.7	48 61	5803 9132	5603 14935	2304 3721	2304 6025		0.33	<del></del>
1 3	60	176.7	187.6	74	13882	26617	5476	11501		0.33	
4	70	207.8	245.8	87	21385	50202	7589	19070		0.28	<del>;                                    </del>
5	80	239	242.3	100	24230	74432	10000	29070	2.56	0.33	0.317
										<del></del>	
,					·····				<del></del> -	<u> </u>	<del></del>
		<del></del>		CYCLE #	2 (Raw Data	n)					
Deni Carial	DSPTK (%)	141 St 72-01	Timber /ET			TDEV (est)		144 /a-a\	TDEV (act)	<u> </u>	<del></del>
2	100	50	40	30	91	13.9		160.3	19.2	<del></del>	<del></del>
1	100	40	10	36	110.2	14.9		115.7	16.6		+
3	100	60	20	48	149.1	16.7		184.6	19.5		
5	100	80 70	50 30	40 49	123.1 152.4	15.6 16.9		305.1 227.4	22.3 20.6	<u> </u>	
	100		30	49	132.4	10.9		221.4	20.6	ļ	<del></del>
Proj.Seriel		MM (est)		Q		sum MM(act)*Q	0/2		Coefficient		Comp Prod
2	50	155.7	100.3	61	9778	9778	3721	3721		0.31	
3	60	123.1 188.5	115.7 184.6	48 74	5554 13660	15332 26692	2304 5476	6025 11501	<del></del>	0.35 0.33	<u> </u>
5	80	255	305.1	100	30510	59502	10000	21501	<del></del>	0.35	
4	70	221.6	227.4	87	19784	79286	7569	29070	2.73	0.31	0.302
<del></del>	<del></del>		ļ	<b></b>					<del></del>		
<del></del>	<u> </u>	CVC	1 E #2 /D	Deta 1000	OCIDTY W	ith Underestimatio			<del></del>	<b> </b>	<del> </del>
			•		· ·		10)				
Proj.Seriel	100 DSIPTK (%)	KDSI (act)	Under (%)	KOSI (est)	MM (est)	TUEV (est) 18.2		MM (act) 221.3	TDEV (act) 20.2	<u> </u>	<del>}</del> -
3	100	60	40	36	117.6	15.3		198.6	19.5	<del></del> -	<del> </del> -
1	100	40	50	20	63.4	12.1		124.8	18.4		<del></del>
2	100	50	10	45	148.6	16.7		156	18.2		
5	100	80	30	56	187	18.2		273.1	21.4	ļ	<del></del>
Pro Serial	KDSI (act)	MM (est)	MM(act)	0	Mac YO	sum MM(act)*Q	0/2	sum Q/2	Coefficient	Productivin	Comp Prod
4	70	236.3	221.3	87	19253	19253	7569	7569		0.32	132.00
3	60	201	198.6	74	14696	33949	5476	13045		0.3	
1 2	40 50	131.3 166	124.8 156	48 61	5990 9516	39939 49455	2304 3721	15349 19070	<u> </u>	0.32 0.32	<b></b>
5	80	271.9	273.1	100	27310	76765	10000	29070	2.64	0.32	0.308
									<del></del>		
	!			1	<u> </u>	<u> </u>	<del></del>		<del></del>	<del> </del>	<del> </del>
						ith Underestimatio	n)				<del></del> -
	DSIPTK (%)					TDEV (est)			TDEV (act)		
1	100	70 40	40 30	42 28	133.7 87.3	16.1 13.7		242.2 119.1	20.7 17.3	<u> </u>	
5	100	80	20	64	208	19		257.4	21.6	<del> </del>	<del>;</del>
2	100	50	50	25	77.5	13.1		165	19.6		
3	100	60	10	54	174	17.8		181.5	19.3	ļ	<del></del>
Proj.Serial	KDSI (act)	MM (est)	MM(act)	-	Mariya	sum MM(act)*Q	0/2	eum (X2	Coefficient	Drockschado	Como Drodi
4	70	228.5	242.2	87	21071	21071	7569	7569	- WOULDER	0.29	Villa Fidd
1	40	127	119.1	48	5717	26788	2304	9873		0.34	
5	80	262.9	257.4	100	25740	52528	10000	19873		0.31	
3	50 60	160.5 194.4	165 181.5	61 74	10065	62593 76024	3721 5476	23594 29070	2.62	0.3	0.311

	IDSPTK (%)	TOTAL CONT	115-4-7	Total Inch	THE COLD	100-17 (		1000	**************************************		
79.30						TOEV (est)			TDEV (act)		
	100		40	48	152.6	16.9		266.2	21.7	<u></u>	
	100	70	10	63	203.1	18.8		214	20.5		
	100	50	30	36	100.5	14.9		153.4	18.4	L	
	100	60	50	30	93.2	14		203.5	20.3	<u> </u>	_
	100	40	20	32	99.7	14.4		117.6	16.9		
roi Seriel	KUSI (ed)	MM (cel)	MM(act)	Q	MM(act) Q	SUM MAKECITO	0/2	sum 0°2	Coefficient	Productivity	Como Pro
-5	80	260.9	286.2	100	20520	25520	10000	10000	-	0.26	
4	70	226.8	214	87	18618	47238	7569	17569		0.33	<del></del>
2	50	159.3	153.4	61	9357	56595	3721	21290		0.33	
3	60	192.9	203.5	74	15069	71654	5476	26766		0.29	
1	40	126	117.6	48	5645	77299	2304	29070	2.66	0.34	0.308
	1	CYC	LE #6 (Rew	Data, 100%	DSIPTK, W	ith Underestimatio	ın)				
roi Sarial	DSPIK(%)	(OSI (GG)	Under (%)	KOSI (est)	MM (est)	TDEV (cst)	n)		TOEV (act)		
1	100	KOSI (act)	Under (%)	KDSI (est) 24	VAM (est) 74.8	TDEV (est) 12.9	m)	121.3	10EV (act)		
roi Sertel	100	KOSI (sci) 40 50	Under (%) 40 20	KOSI (est) 24 40	74.8 128	10EV (est) 12.9 15.8	n)	121.3 150.4	17.5 18		
1	100 100 100	(COSI (act) 40 50 60	Under (%) 40 20 30	KIDSI (est) 24 40 42	128 134.7	TDEV (est) 12.9 15.8 16.1	m)	121.3 150.4 191	17.8 18 19.4		
1	100 100 100 100	KOSI (sct) 40 50 60 70	Under (%) 40 20 30 50	KDSI (est) 24 40 42 35	74.8 128 134.7	12.9 15.8 16.1	n)	121.3 150.4 191 252.9	17.8 18 19.4 21.1		
1	100 100 100	(COSI (act) 40 50 60	Under (%) 40 20 30	KIDSI (est) 24 40 42	128 134.7	TDEV (est) 12.9 15.8 16.1	n)	121.3 150.4 191	17.8 18 19.4		
1 2 3 4 5	100 100 100 100	40 50 60 70 80	Under (%) 40 20 30 50	KOSI (est) 24 40 42 35 72	14.8 128 134.7 111.2 237.2	12.9 15.8 16.1		121.3 150.4 191 252.9 250.1	17.8 18 19.4 21.1	Productivity	Como Pir
1 2 3 4 5	100 100 100 100 100	40 50 60 70 80	Under (%) 40 20 30 50	KOSI (est) 24 40 42 35 72	14.8 128 134.7 111.2 237.2	10EV (est) 12.9 15.8 16.1 15		121.3 150.4 191 252.9 250.1	17.8 18 19.4 21.1 21.8	Productivity 0.33	Comp Pr
1 2 3 4 5	100 100 100 100 100 100 KOSI (act) 40 50	40 50 60 70 80 MM (est)	20 30 50 10	KOSI (est) 24 40 42 35 72	14.8 128 134.7 111.2 237.2	10EV (est) 12.9 15.8 16.1 15 20	92	121.3 150.4 191 252.9 250.1	17.8 18 19.4 21.1 21.8		Сотр Ри
1 2 3 4 5	100 100 100 100 100 100 KDSI (act)	KDSI (act) 40 50 60 70 80 MM (act) 128	Under (%) 40 20 30 50 10 888(act) 121.3	KOSI (est) 24 40 42 35 72	74.8 128 134.7 111.2 237.2 MM/sct/10	TUEV (est) 12.9 15.8 16.1 15 20 sum MM(ect)**O	→ 0/2 2304	121.3 150.4 191 252.9 250.1	17.8 18 19.4 21.1 21.8	0.33	Сопр Ри
1 2 3 4 5	100 100 100 100 100 100 KOSI (act) 40 50	(OS) (act) 40 50 60 70 80 MM (est) 128 161.7	Under (%) 40 20 30 50 10  Under (%) 121.3	24 40 42 35 72 Q 48 61	134.7 111.2 237.2 1MM/nct/Q 5822 9174	10EV (est) 12.9 15.8 16.1 15 20 sum MA (est)*O 5822 14006	CP2 2304 3721	121.3 150.4 191 252.9 250.1 sum QP2 250.4 6025	17.8 18 19.4 21.1 21.8	0.33 0.33	СопрРк

# APPENDIX H. NORMALIZATION CALIBRATION STRATEGY: UNDERSIZING - NO LEARNING

1		CYC	CLE PI (Rom	Date, 100%	DEPTK, W	fith Undersett	matten)	-				
75155	Me aldes	1. 1 Total	United	1,08760	Tabl (each	HILLY COL		Mail (act)	DUEV FOR	<del></del>	-,	
	100	40	40	24	67.5	12.4	•	120.9	18.5		<del></del>	<del></del>
1-3-	100	- 50 - 60	30	40	115.4	15.2		140.7	18.6	<b>I</b>		
1-1-	100	+ <del>- 8</del> -	<del></del>	35-	1003	14.4		245.8	21.9	<del> </del>	<del></del>	
1	100		10	72	214	19.2		242.3	22.3	<del> </del>	<del></del>	<del></del>
												<del>,</del>
		115.4	120.3	1128		THE COLUMN	5408	204	80003	Coefficient	Production	Comp Prod
1 · · · · ·		146.9	140.7	142.5	81	- 223	14088	3721	- 625	<del></del>	0.33	·•·-
3	- 60	176.7	187.6	172.6	74	12767		5476	11501		0.32	
4	70	207.3	246.8	204.4	67	17763	41000	7500	19070	1	0.28	
	. 60	239	242.3	754.4	100	23440	6533	10000	29070	2.35	0.33	0.317
,	<del></del>	<del></del>	<del></del>	<del></del> -		<del></del>		<del></del>	<del></del>	<del></del>	<del></del>	<del></del>
	<del></del>	<del></del>	<del>†</del>	1				<del></del>		<del></del>	<del></del>	<del></del>
		CYCLE	#2 (Normal	and Date, 12	S% DEIPTH	C With Under	elimetica)				-	
	No. of Carl								11151/6	<u> </u>		
-	1 (a)		130		100	TOEV 600		155.3	110EV (96)	<del> </del>	<del></del>	<del></del>
1	100	- 85	10	38	101.2	14.5		115.1	17.1	<del>                                     </del>		<del></del>
3	100	- 60	20	40	136.9	18.2		181.5	19.8			
3	100	- 66	90	40	113	15.1		314	23.4		<del></del>	
	140	70			130.9	16.3		224.8	21.1	<u></u>	<del> </del>	<del></del>
The Real Property lies	10 Con	Wiles.	THE STATE OF	100	0	THE PERSON NAMED IN		02	mm (2*2	200	P	Comp Prod
7	. 50	1423	1853	124	61	5005		3721	3721	1	0.32	Comp Prod
	40	113	115.1	1123	48	5400	14068	2304	0025		0.36	
3	60	173	181.5	172.9	74	12798	20061 50561	5476	11901		0.33	
<del></del>	70	204.1	314 234.4	234.8 24.2	100 87		50.061 663.26	10000	21501 29070	2.36	0.25 0.31	
<del></del>	<del>+ 'Y</del> -					17765	44344	7500	AVIU		0.51	0.303
	<u> </u>		<del> </del>			+			:		<del></del>	†
		,	<u> </u>					·			<del></del>	<del></del>
		CYCLE	#3 (Normal	bed Date, 10	0% DBIPT)	C With Under	attraction)	·				
President	HO PIGGS						setimation)	(Was)	TOEV (SC)			
7-1	III. ALYON	70	U TO	100160	MAN (cont) 1600.9	172	attraction)	216.1	110EV (20)			
744	100	70 80	10 A	ICH (art)	180.5 101.2	172 14.5	sethration)	192.6	20.2			
74	100	70 60 40	40 50	147 (81 (and) 38 30	160.9 101.2 54.6	10 EV (650) 172 14.5 11.4	nethralion)	216.1 192.6 122.6	20.2 20.4 19.6			
3	100 100 100	60 60 80 80	40 50 10	ICH (art)	100.9 101.2 54.6 127.9	17/2 14.5 11.4 15.8	astrostori)	216.1 192.8 122.8 145.8	20.2 20.4 19.5 18.4			
3 1 2 3 3	100 100 100 100	70 60 40 50	20 40 50 10 30	30 20 45	180.8 101.2 54.6 127.9 180.9	110.2V(0.50) 17.2 14.5 11.A 15.8 17.2		216.1 192.8 122.8 146.8 262.5	20.2 20.4 19.6			
3 1 2 3	100 100 100 100	70 60 40 50 60	20 40 50 10 30	10 81 (ant) 93 93 20 46 53	180.8 101.2 54.6 127.9 160.9	10 PV(60) 172 14.5 11.4 15.8 172		216.1 192.8 122.8 145.8 282.5	20.2 20.4 19.8 18.4 22.3			/(Comp Prod
3 1 2 3 5	100 100 100 100 100 100	70 70 80 80 50 60 80 80	90 40 50 10 30 30	10 (art) 9 9 20 46 5 5 10 10 10 10 10 10 10 10 10 10 10 10 10	180.9 180.9 101.2 54.8 127.9 180.9	110.EV (666) 17.2 14.5 11.4 15.8 17.2	ann Materio C	216.1 192.8 122.8 146.8 262.5	20.2 20.4 19.8 18.4 22.3		0.32	//Comp Prod
3 1 2 3 3	100 100 100 100 100 100 100 100 100	70 60 50 50 60 60 60 60 200.4	20 40 50 10 30 30 10 10 10 10 10 10 10 10 10 10 10 10 10	35 20 46 34 201.3	180.9 160.9 101.2 54.6 127.9 160.9	10 PV (668) 17/2 14/5 11/4 15/8 17/2	177/4 30576	216.1 192.8 122.8 146.8 262.5 0°2 7580 5476	20.2 20.4 19.8 18.4 22.3 sum Q*2 7389 13045		0.32	/(Comp Prod
7 3 1 2 3 5 7 7 8	100 100 100 100 100 100	70 70 80 80 50 60 80 80	90 40 50 10 30 30	10 (art) 9 9 20 46 5 5 10 10 10 10 10 10 10 10 10 10 10 10 10	180.9 180.9 101.2 54.8 127.9 180.9	110.EV (666) 17.2 14.5 11.4 15.8 17.2	ann Materio C	216.1 192.8 122.8 146.8 262.5	20.2 20.4 19.8 18.4 22.3		0.32	/Comp Prod
3 -1 -2 -5 -5 -7 -4 -1 -1	100 100 100 100 100 100 100 100 100 100	#28 640 #0 #0 50 60 #8 640 173 113	40 50 10 30 28 10 30 28 12 12 12 12 12	35 36 20 46 36 36 36 36 37 37 317 317 317 317 317	NM (cg) 180.9 101.2 54.6 127.9 160.9	10 PV (668) 17/2 14/5 11/4 15/8 17/2	17774 30576 5068	216.1 192.8 122.8 146.8 282.5 0°2 7'589 5478 2504	20.2 20.4 19.6 18.4 22.3 sum Q*2 7380 13045 15346		0.32 0.31 0.33	//Comp Prod
3 1 2 3 5	100 100 100 100 100 100 100 100 100 100	#0 #0 #0 #0 #0 #0 #0 #0 #0 #0 #0 #0 #0 #	20 40 50 10 30 214.1 122.8 145.8	98 20 46 38 201.3 701.3 173 112.7 142.4	180.9 180.9 101.2 54.6 127.9 160.9 C C 74 46 61	112EV (98) 17/2 14.5 11.4 15.8 17.2 17/4 12802 5410	17774 30576 3058 44672	216.1 162.8 122.8 145.8 262.5 272 7580 5476 2504 3721	20.2 20.4 19.6 16.4 22.3 seem Q*2 7586 13045 15346 19070	Core	0.32 0.31 0.33 0.34	
3 -1 -2 -5 -5 -7 -4 -1 -1	100 100 100 100 100 100 100 100 100 100	#0 #0 #0 #0 #0 #0 #0 #0 #0 #0 #0 #0 #0 #	20 40 50 10 30 214.1 122.8 145.8	98 20 46 38 201.3 701.3 173 112.7 142.4	180.9 180.9 101.2 54.6 127.9 160.9 C C 74 46 61	112EV (98) 17/2 14.5 11.4 15.8 17.2 17/4 12802 5410	17774 30576 3058 44672	216.1 162.8 122.8 145.8 262.5 272 7580 5476 2504 3721	20.2 20.4 19.6 16.4 22.3 seem Q*2 7586 13045 15346 19070	Core	0.32 0.31 0.33 0.34	
3 -1 -2 -5 -5 -7 -4 -1 -1	100 100 100 100 100 100 100 100 100 100	70 60 60 50 60 60 208.4 173 142.9 234.1	20 40 50 10 30 20 11 12 12 14 14 14 14 14 14 14 14 14 14 14 14 14	100 (art) 36 20 46 58 100 (art) 173 173 112.7 142.4 23.3	180.9 180.9 101.2 54.8 127.9 180.9 C 87 74 46 61 100	108V(98) 1/2 14.5 11.4 15.8 17.2 12802 5410 5410 5410 5410 5410	30576 30405 30405 44572 68302	216.1 162.8 122.8 145.8 262.5 272 7580 5476 2504 3721	20.2 20.4 19.6 16.4 22.3 seem Q*2 7586 13045 15346 19070	Core	0.32 0.31 0.33 0.34	
3 1 2 5 7 7 1 2 3 1 2 3	100 100 100 100 100 100 100 100 100 100	### (###)  ###  ###	United 163   10   10   10   10   10   10   10   1	1008 (art) 36 20 45 45 28 1006 (art) 173 172.7 142.4 238.3	MM (cgb) 180.3 191.3 191.2 54.6 127.9 160.9 87 74 61 100	10EV (set) 172 14.5 11.6 15.8 17.2 1774 12802 5410 865 23830	30576 30405 30405 44572 68302	218.1 192.8 122.8 146.8 282.5 0/2 7580 5478 2304 3721 10000	20.2 20.4 19.6 18.4 22.3 sum C <sup>2</sup> 2 7388 1.9045 15349 19070 25079	2.36	0.32 0.31 0.33 0.34	
1	100 100 100 100 100 100 100 100 100 100	### (###) ### ### ### ### ### ### ### ### ##	Under (%)   Unde	1808 (ast) 38 20 46 38 173 173 173 173 122.7 142.4 285.3 286.3	MM (cap) 180.9 101.2 54.6 127.9 100.9 2 87.7 44 61 100 100 100 100 100 100 100	10EV (cc) 172 14.5 15.8 17.2 15.8 17.2 17.7 17.7 17.7 18.6 17.2 18.6 17.2 18.6 17.2 18.6 18.6 18.6 18.6 18.6 18.6 18.6 18.6	30576 30405 30405 44572 68302	216.1 192.6 122.6 145.6 262.5 145.6 262.5 279.0 250.4 100000	20.2 20.4 19.8 18.4 22.3 seen Q*2 13045 15349 19070	2.36	0.32 0.31 0.33 0.34	
3 1 2 5 7 7 1 2 3 1 2 3	100 100 100 100 100 100 100 100 100 100	### (600) ### (600) ### (600) ### (600) ### (600) ### (600) ### (600) ### (600) ### (600) ### (600)	United (%)   122.6   145.8   122.6   145.8	38 38 20 46 38 20 173 172.7 142.4 238.3 2016. 10	MM (cap) 180.3 191.3 54.8 127.9 180.3 7 7 46 61 100	10EV (cold) 172 14.5 11.4 15.8 17.2 177.4 128.02 177.4 128.02 128.02 10.00 10.	30576 30405 30405 44572 68302	214.1 192.8 122.8 146.8 282.5 0°2 758 5478 2304 3721 10000	20.2 19.6 19.6 18.4 22.3 seem Q*2 7380 13045 15340 19070 28070	2.36	0.32 0.31 0.33 0.34	
3 1 2 5 7 7 1 2 3 1 2 3	100 100 100 100 100 100 100 100 100 100	### (###) ### ### ### ### ### ### ### ### ##	Under (%)   Unde	1808 (ast) 38 20 46 38 173 173 173 173 122.7 142.4 285.3 286.3	MM (cap) 180.9 101.2 54.6 127.9 100.9 2 87.7 44 61 100 100 100 100 100 100 100	10EV (cc) 172 14.5 15.8 17.2 15.8 17.2 17.7 17.7 17.7 18.6 17.2 18.6 17.2 18.6 17.2 18.6 18.6 18.6 18.6 18.6 18.6 18.6 18.6	30576 30405 30405 44572 68302	216.1 192.6 122.6 145.6 262.5 145.6 262.5 279.0 250.4 100000	20.2 20.4 19.8 18.4 22.3 seen Q*2 13045 15349 19070	2.36	0.32 0.31 0.33 0.34	
4   1   2   2   2   2   2   2   2   2   2	100 100 100 100 100 100 100 100 100 100	### (### (### )  #	United (%)   122.6   122.6   122.6   122.6   122.6   122.5   122.6   122.5	1008 (cm) 38 30 46 36 46 37 173 172.7 142.4 238.3 204.3 204.3 204.3 204.3 204.3 204.3 204.3 204.3	MM (col) 100.3 100	10EV (cg) 172 44.5 11.4 15.8 17.2 17.2 17.4 15.8 17.2 17.4 15.8 17.2 17.4 15.8 17.2 17.4 15.8 17.2 17.4 15.8 17.2 17.4 15.8 17.2 17.4 15.8 17.2 17.5 17.5 17.5 17.5 17.5 17.5 17.5 17.5	30576 30405 30405 44572 68302	244.1 192.8 122.8 146.8 282.5 292.5 292.5 293.8 10000	20.2 19.6 19.6 18.4 22.3 5eem Q*2 7580 13045 15340 19070 28070	2.36	0.32 0.31 0.33 0.34	
7 1 2 3 3 1 1 2 3 1 2 3 1 1 2 3 1 1 1 2 3 1 1 1 1	100 100 100 100 100 100 100 100 100 100	80 80 80 80 80 80 80 80 80 80 80 80 80 8	Under (%)   10   10   10   10   10   10   10   1	1808 (ast) 38 20 46 38 173 173 173 142.4 285.3 285.6	MM (cap) 180.9 190.2 54.6 127.9 180.9 2 87 74 46 61 100 119 77.7 185.2	10EV (cc) 172 14.5 15.8 172 15.8 172 172 172 17774 178562	30576 30405 30405 44572 68302	216.1 192.8 122.8 146.8 282.5 27.5 27.5 2504 2504 2504 2504 2504 2504 2504 250	20.2 19.8 19.4 22.3 seen Q*2 13045 15349 19070 28070	2.36	0.32 0.31 0.33 0.34	
7 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 1 2 3 3 1 1 2 3 3 1 1 1 1	100 100 100 100 100 100 100 100 100 100	### (###)  ### (###)	## (Ptomatile 19)	1808 (ast) 38 38 20 46 38 173 173 172.7 142.4 238.3 28 64 25 54	MM (cap) 180.3 191.2 54.6 127.9 180.3 127.9 180.3 177.7 44 61 100 119 77.7 185.2 69 154.9	10EV (cc) 172 14.5 15.8 172 15.8 172 15.8 172 15.8 172 15.8 172 15.8 172 15.8 172 15.8 172 15.8 15.8 15.8 15.8 15.8 15.8 15.8 15.8	90576 90606 44572 68302	214.1 192.8 122.8 146.8 22.5 25.5 25.5 25.04 25.04 25.04 25.04 25.04 25.04 25.04 25.05 10000 25.05 119.05 119.05 119.05	20.2 19.6 19.6 18.4 22.3 seen Q*2 13045 15349 15349 15349 25079	235	0.52 0.31 0.33 0.34 0.3	0.319
7 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 1 2 3 3 1 1 2 3 3 1 1 1 1	100 100 100 100 100 100 100 100 100 100	### (###)  ### (###)	United (%)   10   10   10   10   10   10   10   1	38 38 38 38 38 38 38 38 38 38 38 38 38 3	MM (cap) 180.3 101.3 54.8 127.9 180.3 74 48 61 100 0% DSFTN 185.2 69 1154.9	10EV (cg) 172 44.5 11.4 15.8 17.2 11.5 11.7 15.8 17.2 17.7 17.7 17.7 17.7 17.7 17.7 17.7	Description	214.1 192.8 122.8 146.8 22.5 25.5 25.5 25.04 25.04 25.04 25.04 25.04 25.04 25.04 25.05 10000 25.05 119.05 119.05 119.05	20.2 20.4 19.6 18.4 22.3 288 13045 13070 28070 28070 21.4 18 22.2 20.4 19.8	235	0.32 0.31 0.33 0.34 0.3	0.319
7 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 1 2 3 3 1 1 2 3 3 1 1 1 1	100 100 100 100 100 100 100 100 100 100	### (400)  ### (400)  ### (400)  ### (400)  ### (400)  ### (400)  ### (400)  ### (400)	## (Ptomatile 19)	1808 (ast) 38 38 20 46 38 173 173 172.7 142.4 238.3 28 64 25 54	MM (cap) 180.3 191.2 54.6 127.9 180.3 127.9 180.3 177.7 44 61 100 119 77.7 185.2 69 154.9	10EV (cc) 172 14.5 15.8 172 15.8 172 15.8 172 15.8 172 15.8 172 15.8 172 15.8 172 15.8 172 15.8 15.8 15.8 15.8 15.8 15.8 15.8 15.8	90576 90606 44572 68302	216.7 192.8 192.8 122.8 145.8 282.5 145.8 282.7 193.9 194.7 250.6 199.7 250.6 199.7 250.6 199.7 250.6	20.2 19.6 19.6 18.4 22.3 seen Q*2 13045 15349 15349 15349 25079	235	0.52 0.31 0.33 0.34 0.3	0.319
7 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 1 2 3 3 1 1 2 3 3 1 1 1 1	100 100 100 100 100 100 100 100 100 100	### (###)  ### (###)	Under (%)   10   10   10   10   10   10   10   1	33 36 36 36 36 36 36 36 36 36 36 36 36 3	MM (cap) 180.3 191.3 54.8 127.9 180.3 77 48 61 100 100 100 119 77.7 186.2 87 48 119 17.7 186.2 154.9	10EV (cal) 172 14.5 11.4 15.8 17.2 17.7 17.7 17.7 12.0 12.0 12.0 12.0 12.0 12.0 12.0 12.0	Description	246.1 192.8 192.8 192.8 192.8 192.8 192.8 192.8 192.8 192.8 192.8 192.8 192.8 192.8 192.8 192.7 192.0 192.8 192.7 192.0 192.8 192.7 192.8 192.7 192.8 192.7 192.8 192.7 192.8 192.7 192.8 192.7 192.8	20.2 20.4 19.6 18.4 18.4 22.3 23.8 19.045 19.070 28070 28070 21.4 18 22.2 20.4 19.8 19.8 19.8 19.8 19.8 19.8 19.8 19.8	235	0.32 0.31 0.33 0.34 0.3 0.3 0.3 0.3 0.33	0.319
7 3 1 2 3 1 2 3 1 2 3 1 2 3 1 2 3 1 1 2 3 3 1 1 2 3 3 1 1 1 1	100 100 100 100 100 100 100 100 100 100	### (###)  ### (###)	Under (%)   159.5	1808 (ast) 38 30 46 30 46 31 173 172.7 142.4 238.3 286 64 25 64 25 64 25 64 25 112.7 288.3 112.7 288.3	MM (cap) 180.9 190.9 54.6 127.9 190.9 C T 74 46 1100 119 71.7 186.2 85 154.9 2 87 48 100 119 119 119 119 119 129 130 149 150 150 150 150 150 150 150 150	110EV (980) 17.2 14.5 11.4 15.8 17.2 1846(66) C3 17.2 1841(66) C3 17.2 18410 18456 18410 18410 18410 18410 18410 18410 18410 18410 18410 18410 18410 18410 18410 18410 1854 1855 1855 1855 1855 1855 1855 1855	Page   Marked Co.     177/4   30676   30676   30676   30676   30676   30676   30676   30676   30677	246.1 192.8 122.8 146.8 282.5 146.8 282.5 146.8 282.5 146.8 282.5 146.8 282.5 146.8 282.5 146.8 166.0	20.2 20.4 19.8 18.4 22.3 18.0 13.0 13.0 13.0 15.0 19.0 2 21.4 18 22.2 20.4 19.8 18 22.2 20.4 19.8 19.8 19.8 19.8 19.8 19.8 19.8 19.8	235	0.52 0.31 0.33 0.34 0.3 0.3 0.3 0.33 0.32 0.31	0.319
1	100 100 100 100 100 100 100 100 100 100	### (###)  ### (###)	Under (%)   10   10   10   10   10   10   10   1	33 36 36 36 36 36 36 36 36 36 36 36 36 3	MM (cap) 180.3 191.3 54.8 127.9 180.3 77 48 61 100 100 100 119 77.7 186.2 87 48 119 17.7 186.2 154.9	10EV (cal) 172 14.5 11.4 15.8 17.2 17.7 17.7 17.7 12.0 12.0 12.0 12.0 12.0 12.0 12.0 12.0	Description	246.1 192.8 192.8 192.8 192.8 192.8 192.8 192.8 192.8 192.8 192.8 192.8 192.8 192.8 192.8 192.7 192.0 192.8 192.7 192.0 192.8 192.7 192.8 192.7 192.8 192.7 192.8 192.7 192.8 192.7 192.8 192.7 192.8	20.2 20.4 19.6 18.4 18.4 22.3 23.8 19.045 19.070 28070 28070 21.4 18 22.2 20.4 19.8 19.8 19.8 19.8 19.8 19.8 19.8 19.8	235	0.32 0.31 0.33 0.34 0.3 0.3 0.3 0.3 0.33	0.319

Pro Serie	OSPIK (%)	KOSI (ad)	Under (%)	KDSI (est)	LEM (ceal)	TOEV (call)		MM (act)	ITUEV (act)	
-5	100	80	40	48	136.9	16.2		284.5	22.5	
4	100	70	10	63	182.1	18.1		208.7	21.2	
2	100	50	30	35	98.3	14.3		152	19	1
3	100	60	50	30	83.6	13.4		198.6	21.2	
1	100	40	20	32	89.4	13.8		118	17.5	1
David Cont	ROSI (act)	100/64	Marin .	LE Marrie		THE WORLD	ourn MM(act)*Q	042	sum CP2	Coefficient Productivity Comp Pro

Pro. Seriel	KUSI (act)	MM (out)	MM(act)	Mal(norm)	0	VM(act)*Q	O'(los)MM mus	Q*2	sum Q*2	Conticion	Productive	Comp Prod
5	80	234.1	284.6	236.6	100	23660	23660	10000	10000	,	0.28	
4	70	203.4	208.7	204.3	87	17774	41434	7569	17569		0.34	
7	50	142.9	152	142.5	61	8693	50127	3721	21290		0.33	
3	60	173	198.6	172.8	74	12787	62914	5476	26766		03	
1	40	113	118	112.5	48	5400	68314	2304	29070	2.35	0.34	0.312

Pro Seriel	DSPTK(%)	(DS) (ad)	Under (%)	KOSI (CO)	MM (est)	TDEV (cal)		MM (act)	TDEV (act)	
1	100	40	40	24	66.1	12.3	•	120.7	18.3	
2	100	50	20	40	113	15.1		148.5	18.2	
3	100	60	30	42	119	15.4		187.3	19.4	
4	100	70	50	35	98.3	14.3		245.9	21.4	
5	100	80	10	72	209.5	19.1	•	241.5	21.3	

Pro Serial	KDSI (act)	MM (est)	MM(act)	MM(norm)	Q	MM(act)*Q sum	MM(act)*O	7-2	sum CP2	Contident	Productivity	Comp Prod
1	40	113	120.7	•	48	•	. 2	504	2304		0.33	
2	50	142.9	148.5	-	61		3	721	6025		0.34	
3	60	173	187.3	•	74	•	- 5	176	11501		0.32	
4	70	203.4	245.9	,	87	•	* 75	560	19070		0.28	
3	80	234.1	241.5	•	100		10	000	29070	•	0.33	0.318

# APPENDIX I. NORMALIZATION DATA: UNDERSIZING - NO LEARNING

C	YCLE #1, F	PROJECT	#1	CYCLE #1, PROJECT #2				
KDSI (est)	TDEV (est)	MM (est)	MM (act)	 KDSi (est)	TDEV (est)	MM (est)	MM (act)	
40	18.5	120.9	120.6	 50	18.6	149.7	149.4	
40	18.5	115	115.3	 50	18.6	145	146.2	
40	18.5	110	114.6	 50	18.6	140	145.9	
40	18.5	105	113.4	 50	18.6	135	143.8	
40	18.5	100	112.7	 50	18.6	130	143.1	
40	18.5	95	112.6	50	18.6	125	142.9	
40	18.5	90	112.7	 50	18.6	120	142.6	
40	18.5	85	113.3	 50	18.6	118	142.5	
40	18.5	80	115.4	 50	18.6	115	142.6	

С	YCLE #1, I	PROJECT	#3	 C	PROJECT	ECT #4	
KDSI (est)	TDEV (est)	MM (est)	MM (act)	 KDSI (est)	TDEV (est)	MM (est)	MM (act
60	19.9	187.5	187.3	 70	21.9	245.8	243.7
60	19.9	180	180.1	70	21.9	235	234.1
60	19.9	170	176.9	 70	21.9	220	219.6
60	19.9	160	174.4	70	21.9	210	212.3
60	19.9	155	173.2	70	21.9	200	207.9
60	19.9	150	173	70	21.9	190	205.3
60	19.9	145	172.8	70	21.9	185	204.4
60	19.9	140	173.4	70	21.9	175	204.7
60	19.9	135	174.3	 70	21.9	170	205.3

C	YCLE #1, 1	PROJECT	#5	c	CYCLE #2, PROJECT #2					
KDSI (est)	TDEV (est)	MM (est)	MM (act)	KDSI (est)	TDEV (est)	MM (est)	MM (act)			
80	22.3	242.3	246.7	50	19.5	155.3	159.8			
80	22.3	235	242	50	19.5	150	149.5			
80	22.3	225	238.8	50	19.5	145	146.3			
80	22.3	220	237.6	50	19.5	140	145.4			
80	22.3	215	236.6	50	19.5	130	143.1			
80	22.3	210	236.5	50	19.5	120	142.4			
80	22.3	205	236.4	50	19.5	115	142.6			
80	22.3	200	237.2	50	19.5	110	143.1			
80	22.3	195	238.2	50	19.5	100	146.8			

С	YCLE #2, 1	PROJECT	#1	 C	YCLE #2, PROJECT #3			
KDSI (est)	TDEV (est)	MM (est)	MM (act)	 KDSI (est)	TDEV (est)	MM (est)	MM (act)	
40	17.1	115.1	115.4	 60	19.8	181.5	184.1	
40	17.1	105	113.9	60	19.8	175	178.6	
40	17.1	100	112.9	 60	19.8	165	175.4	
40	17.1	95	112.5	 60	19.8	155	173.5	
40	17.1	93	112.8	60	19.8	145	173.3	
40	17.1	90	112.7	 60	19.8	140	172.9	
40	17.1	85	113.1	 60	19.8	135	174.1	
				 60	19.8	130	175.1	
		· · · · · · · · · · · · · · · · · · ·						

C	YCLE #2, F	PROJECT	#5	 CYCLE #2, PROJECT #4				
KDŞI (est)	TDEV (est)	MM (est)	MM (act)	 KDSI (est)	TDEV (est)	MM (est)	MM (act)	
80	23.4	314	297.1	 70	21.1	224.6	226.9	
80	23.4	285	282.9	70	21.1	215	214.5	
80	23.4	265	264.7	 70	21.1	205	211.1	
80	23.4	245	247.3	 70	21.1	195	206.8	
80	23.4	225	238.8	 70	21.1	185	205.2	
80	23.4	215	237.6	 70	21.1	180	204.5	
80	23.4	205	236.8	70	21.1	175	204.2	
80	23.4	200	237.2	70	21.1	170	204.7	
80	23.4	195	238.2	 70	21.1	165	205.4	

C	YCLE #3, F	PROJECT	#4		CYCLE #3, PROJECT #3				
KDSI (est)	TDEV (est)	MM (est)	MM (act)		KDSI (est)	TDEV (est)	MM (est)	MM (act)	
70	20.2	216.1	220.6		60	20.4	192.6	198.1	
70	20.2	210	212.3		60	20.4	175	178.6	
70	20.2	200	208.7	1	60	20.4	165	175.4	
70	20.2	190	206.2		60	20.4	155	173.5	
70	20.2	180	204.4		60	20.4	150	173.1	
70	20.2	178	294.3		60	20.4	145	173.3	
70	20.2	175	204.4	T	60	20.4	140	173.1	
70	20.2	170	204.7		60	20.4	135	174.1	
70	20.2	165	205.1		60	20.4	130	175.1	

C	YCLE #3, F	PROJECT	#1	с	CYCLE #3, PROJECT #2					
KDSI (est)	TDEV (est)	MM (est)	MM (act)	KDSI (est)	TDEV (est)	MM (est)	MM (act)			
40	19.6	122.8	124.5	50	18.4	145.8	155.9			
40	19.6	115	115.3	50	18.4	140	145.9			
40	19.6	105	113.5	50	18.4	130	143.3			
40	19.6	100	112.9	50	18.4	125	142.8			
40	19.6	97	112.8	50	18.4	120	142.7			
40	19.6	95	112.7	50	18.4	115	142.4			
40	19.6	90	112.7	50	18.4	110	142.9			
40	19.6	85	113.5	50	18.4	105	143.7			
40	19.6	80	114.8	50	18.4	100	145.5			

C	YCLE #3, F	PROJECT	#5	С	CYCLE #4, PROJECT #4						
KDSI (est)	TDEV (est)	MM (est)	MM (act)	KDSI (est)	TDEV (est)	MM (est)	MM (act)				
80	22.3	262.5	262.3	70	21.4	233.8	233.1				
80	22.3	250	249.3	70	21.4	210	212.2				
80	22.3	230	241	70	21.4	200	208				
80	22.3	215	237.2	70	21.4	190	205.6				
80	22.3	210	236.9	70	21.4	180	204.4				
80	22.3	205	236.3	70	21.4	175	204.1				
80	22.3	200	236.8	70	21.4	170	205.2				
80	22.3	195	237.2	70	21.4	160	206.3				
80	22.3	190	238.5	70	21.4	155	209.1				

С	YCLE #4, F	ROJECT	#1	 C'	#5		
KDSI (est)	TDEV (est)	MM (est)	MM (act)	 KDS! (est)	TDEV (est)	MM (est)	MM (act)
40	18	119.7	119.6	80	22.2	250.6	249.8
40	18	110	115.1	80	22.2	240	245.5
40	18	105	113.6	80	22.2	220	237.7
40	18	100	113	80	22.2	215	236.7
40	18	95	112.7	 80	22.2	210	236.3
40	18	90	112.7	80	22.2	205	236.4
40	18	85	113.2	80	22.2	200	237.3
40	18	80	114.8	80	22.2	195	238.2
40	18	75	118				

(	CYCLE #4, F	PROJECT	#2		CYCLE #4,	PROJECT	#3
KDSI (est)	TDEV (est)	MM (est)	MM (act)	KDSI	(est) TDEV (est)	MM (est)	MM (act)
50	20.4	159.5	159	60	19.8	176.9	178.7
50	20.4	140	145.3	60	19.8	160	174.4
50	20.4	130	142.9	60	19.8	155	173.8
50	20.4	125	142.3	60	19.8	150	173.1
50	20.4	120	142.7	66	19.8	145	172.9
50	20.4	115	143.4	60	19.8	140	173.5
	<del></del>			60	19.8	135	174
			· · · · · · ·	60	19.8	130	175.4

C,	YCLE #5, P	PROJECT	#5	 C	YCLE #5, F	PROJECT	#4
KDSI (est)	TDEV (est)	MM (est)	MM (act)	 KDSI (est)	TDEV (est)	MM (est)	MM (act)
80	22.5	284.6	282.6	 70	21.2	208.7	211.8
80	22.5	260	259.3	 70	21.2	200	208
80	22.5	240	245.5	 70	21.2	190	205.7
80	22.5	220	237.5	70	21.2	180	204.6
80	22.5	215	237	70	21.2	175	204.3
80	22.5	210	236.6	70	21.2	170	205
80	22.5	205	236.8	 70	21.2	165	205.7
80	22.5	200	237.1		•		·
				l			

C	YCLE #5, F	PROJECT	#2	 C	YCLE #5, F	PROJECT	#3
KDSI (est)	TDEV (est)	MM (est)	MM (act)	 KDSI (est)	TDEV (est)	MM (est)	MM (act)
50	19	152	151.5	60	21.2	198.6	198
50	19	140	145.4	60	21.2	180	180.2
50	19	130	143.2	60	21.2	160	173.8
50	19	125	142.5	60	21.2	155	173.3
50	19	120	142.6	60	21.2	150	172.8
50	19	115	142.5	60	21.2	145	173.6
50	19	110	143.1	60	21.2	140	174.4
50	19	105	144.5	 60	21.2	135	175

CYCLE #5, PROJECT #1											
KDSI (est)	TDEV (est)	MM (est)	MM (act)								
40	17.5	118	117.7								
40	17.5	110	114.7								
40	17.5	105	113.5								
40	17.5	100	113								
40	17.5	95	1125								
40	17.5	90	112.6								
40	17.5	85	113								
40	17.5	80	114,4								
40	17.5	70	119.7								

# APPENDIX J. CONVENTIONAL CALIBRATION STRATEGY: UNDERSIZING - 75% DSIPTK

			CLE #1(Raw		,						
roi Seriel	DSIPTK (%)					TDEV (est)		MM (act)	TDEV (act)	L	
	75	40	40	24	67.5	12.4		144.7	20.2		<del>-</del>
2	75	50	20	40	115.4	15.2		181.2	20.9	<b>.</b>	
3	75	60	30	42	121.5	15.5		221.8	22.4		
4	75	70	50	35	100.3	14.4		307.8	24.9	L	
5	75	80	10	72	214	19.2		289.8	25.1	L	
- Cara	KOSI (act)	NAA (oos)	MM(act)	۵	8.88(mas)900 i	sum MM(act)*Q	Q*2	sum Q^2	Coefficient	Part 14	Comp D
1	40	115.4	144.7	48	6946	6946	2304	2304	COGRECAGE	0.28	Colle
2	50	145.9	181.2	61	11053	17999	3721	6025	<del></del>	0.28	<del></del>
3	60	176.7	221.8	74	16413	34412	5476	11501		0.27	
4	70	207.8	307.8	87	26779	61191	7569	19070	<del></del>	0.23	
5	80	239	289.8	100	26980	90171	10000	29070	3.1	0.28	0.262
<u> </u>	- 60	230	200.0	100	20000	30111	1,000	25070	3.1	<u> </u>	0.202
						h Underestimatio	n) 				<del></del>
roj Serial	DSIPTK (%)		Under (%)			TDEV (est)		MM (act)		L	
<u> </u>	/5	50		30	110.2	14.9		187.4	19.9	ļ	
1	75	40	10	36	133.5	16.1		138.1	17.6	L	<u>.                                    </u>
3	75	60	20	48	180.6	18		220.7	20.8	<b></b>	
5	75	80	50	40	149.1	16 7		370.4	23.9	L	
4	75	70	30	49	184.5	18.2		272.7	22.2	J	
mi Camal	MARY James	1 1 1 1 1 1 1	1 Diames		18.8/2-20/2	sum MM(act)*Q	OP3	CHOC CAN	Commence	Dands 4	Come
oj.Senal	KDSI (act) 50	MM (est) 188.5	MM(act) 187.4	G 61	11431	11431	3721	3721	Coefficient	Productivity 0.27	Comp P
<del></del> -	40					18060	2304				<del></del>
		149.1	138.1	74	6629	34392	2304 5476	6025	<del>,</del>	0.29	+
3	60	228.3	220.7		16332			11501	<del></del>	0.27	
5	80	308.7	370.4	100	37040	71432 95157	10000 7569	21501		0.22	1 0000
_4	70	268.4	272.7	87	23725				3.27	0.26	0.252
	-	1			1			29070	-		
			CLE #3 (Ran		DSIPTK, WI	h Underestimatio			1		†
roj.Serial	DSIPTK(%)	(KDSI (act)	CLE #3 (Ran	KDSI (est)	DSIPTK, WILL	th Underestimation		MM (act)	TDEV (act)		
4	75	KDSI (act) 70	CLE #3 (Raw Under (%)	KDSI (est) 56	DSIPTK, With MM (est) 223.9	h Underestimatio		MM (act) 265.8	TDEV (act)		
3	75 75	(KDSI (act) 70 60	CLE #3 (Ran Under (%) 20 40	KDSI (est) 56 36	DSIPTK, Wit MM (est) 223.9 140.8	th Underestimation TOEV (est) 19.5 16.4		MM (act) 265.8 235.4	7DEV (ect) 21.8 20.7		
4 3 1	75 75 75	70 60 40	CLE #3 (Raw Under (%) 20 40 50	KDSI (est) 56 36 20	DSIPTK, Wit   MM/ (est)     223.9     140.8     76	th Underestimation TDEV (est) 19.5 16.4 13		MM (act) 265.8 235.4 148.1	7DEV (ect) 21.8 20.7 19.2		
4 3 1 2	75 75 75 75	(KDSI (act) 70 60 40 50	CLE #3 (Ran Under (%) 40 50	KDSI (est) 56 36 20 45	DSIPTK, Wit MM (est) 223.9 140.8 76 178	10 Underestimation (10 Und		MM (act) 265.8 235.4 148.1 183.1	21.8 20.7 19.2 19.3		
4 3 1	75 75 75	70 60 40	CLE #3 (Raw Under (%) 20 40 50	KDSI (est) 56 36 20	DSIPTK, Wit   MM/ (est)     223.9     140.8     76	th Underestimation TDEV (est) 19.5 16.4 13		MM (act) 265.8 235.4 148.1	7DEV (ect) 21.8 20.7 19.2		
4 3 1 2 5	75 75 75 75 75 75	(KDSI (act) 70 60 40 50 80	CLE #3 (Raw Under (%) 20 40 50 10	KDSI (est) 56 36 20 45 56	DSIPTK, Wit Mill (est) 223.9 140.8 76 178 223.9	TOEV (est) 19.5 16.4 13 17.9 19.5	n)	MM (act) 265.8 235.4 148.1 183.1 323.5	1DEV (ect) 21.8 20.7 19.2 19.3 23.1		
4 3 1 2 5	75 75 75 75 75 75 KDSI (act)	(KDSI (act) 70 60 40 50 80	(CLE #3 (Raw Under (%) 20 40 50 10 30	KDSI (est) 56 36 20 45 56	DSIPTK, Wit MM (est) 223.9 140.8 76 178 223.9	TOEV (est) 19.5 16.4 13 17.9 19.5 sum NM(ect)*O	n)	MM (act) 265.8 235.4 148.1 183.1 323.5 sum Q <sup>2</sup> 2	21.8 20.7 19.2 19.3	Productivity	
4 3 1 2 5	75 75 75 75 75 75 75 KDSI (ect)	(KDSI (act) 70 60 40 50 80 MM (ast) 283.1	CLE #3 (Raw Under (%) 20 40 50 10 30 MM(act) 265.8	KDSI (est) 56 36 20 45 56 Q 87	DSIPTK, With MM (est) 223.9 140.8 76 178 223.9 MM (est) Q 23125	th Underestimation TDEV (est) 19.5 16.4 13 17.9 19.5 19.5 sum NM(est)*Q: 23125	(1) September 10 (1) Se	MM (act) 265.8 235.4 148.1 183.1 323.5 sum Q*2 7589	1DEV (ect) 21.8 20.7 19.2 19.3 23.1	Productivity 0.26	
4 3 1 2 5 roj. Serial 4 3	75 75 75 75 75 75 75 KDSI (act) 70 60	70 60 40 50 80 MM (est) 283.1 240.8	(CLE #3 (Raw Under (%) 20 40 50 10 30 MM/(act) 265.8 235.4	KDSI (est) 56 36 20 45 56 Q 87 74	DSIPTK, With MM (est) 223.9 140.8 76 178 223.9 MM(ect) Q 23125 17420	th Underestimation TDEV (est) 19.5 16.4 13 17.9 19.5 sum NM(ect)*O: 23125 40545	CP2 7589 5476	MM (act) 265.8 235.4 148.1 183.1 323.5 sum Q*2 7569 13045	1DEV (ect) 21.8 20.7 19.2 19.3 23.1	Productivity 0.26 0.25	
4 3 1 2 5 70, Serial 4 3	75 75 75 75 75 75 75 KDSI (act) 70 60 40	(KDSI (act) 70 60 40 50 80 MM (est) 283.1 240.8 157.3	(CLE #3 (Raw Under (%) 40 50 10 30 MM(act) 265.8 235.4	KDSI (est) 56 36 20 45 56 CQ Q 47 74 48	DSIPTK, Wit MM (est) 223.9 140.8 76 178 223.9 MM(est)*Q 23125 17420 7109	TOEV (est) 19.5 16.4 13 17.9 19.5 sum MM(ect)*O: 23125 40545 47654	O*2 7587 5476 2304	MM (act) 265.8 235.4 148.1 183.1 323.5 sum Q*2 7569 13045 15349	1DEV (ect) 21.8 20.7 19.2 19.3 23.1	Productivity 0.26 0.25 0.27	
4 3 1 2 5 5 70, Serial 4 3 1	75 75 75 75 75 75 75 KDSI (act) 70 60 40 50	(KDSI (act) 70 60 40 50 80 MM (est) 283.1 240.8 157.3	CLE #3 (Ran Under (%) 20 40 50 10 30 MM(act) 265.8 235.4 183.1	KDSI (est) 56 36 20 45 56 0 87 74 48 61	DSIPTK, With Mem (est) 223.9 140.8 76 178 223.9 MM(est)*Q 23125 17420 11169	TOEV (est) 19.5 16.4 13 17.9 19.5 19.5 sum MM(ect)*Q 23125 40545 47654 58823	C/2 7589 5476 2304 3721	MM (act) 265.8 235.4 148.1 183.1 323.5 sum CP2 7589 13045 15349 19070	7DEV (act) 21.8 20.7 19.2 19.3 23.1 Coefficient	Productivity 0.26 0.25 0.27 0.27	//Comp P
4 3 1 2 5 5 <b>Serial</b> 4 3	75 75 75 75 75 75 75 KDSI (act) 70 60 40	(KDSI (act) 70 60 40 50 80 MM (est) 283.1 240.8 157.3	(CLE #3 (Raw Under (%) 40 50 10 30 MM(act) 265.8 235.4	KDSI (est) 56 36 20 45 56 CQ Q 47 74 48	DSIPTK, Wit MM (est) 223.9 140.8 76 178 223.9 MM(est)*Q 23125 17420 7109	TOEV (est) 19.5 16.4 13 17.9 19.5 sum MM(ect)*O: 23125 40545 47654	O*2 7587 5476 2304	MM (act) 265.8 235.4 148.1 183.1 323.5 sum Q*2 7569 13045 15349	1DEV (ect) 21.8 20.7 19.2 19.3 23.1	Productivity 0.26 0.25 0.27	
4 3 1 2 5 5 0j.Serial 4 3 1	75 75 75 75 75 75 75 KDSI (act) 70 60 40 50	(KDSI (act) 70 60 40 50 80 MM (est) 283.1 240.8 157.3	CLE #3 (Ran Under (%) 20 40 50 10 30 MM(act) 265.8 235.4 183.1	KDSI (est) 56 36 20 45 56 0 87 74 48 61	DSIPTK, With Mem (est) 223.9 140.8 76 178 223.9 MM(est)*Q 23125 17420 11169	TOEV (est) 19.5 16.4 13 17.9 19.5 19.5 sum MM(ect)*Q 23125 40545 47654 58823	C/2 7589 5476 2304 3721	MM (act) 265.8 235.4 148.1 183.1 323.5 sum CP2 7589 13045 15349 19070	7DEV (act) 21.8 20.7 19.2 19.3 23.1 Coefficient	Productivity 0.26 0.25 0.27 0.27	/Comp P
4 3 1 2 5 70, Serial 4 3 1	75 75 75 75 75 75 75 KDSI (act) 70 60 40 50	(KDSI (act) 70 60 40 50 80 MM (est) 283.1 240.8 157.3 198.8 325.7	CLE #3 (Rand Under (%) 20 40 50 10 30 265.8 235.4 148.1 183.1 323.5	KDSI (est) 56 36 36 45 56  0 87 74 48 61 100	DSIPTK, With Med (est) 223.9 140.8 76 178 223.9 MM(est) Q 23125 17420 11169 32350	TOEV (est) 19.5 16.4 13 17.9 19.5 19.5 sum MM(ect)*Q 23125 40545 47654 58823	O*2 7588 5476 2304 3721 10000	MM (act) 265.8 235.4 148.1 183.1 323.5 sum CP2 7589 13045 15349 19070	7DEV (act) 21.8 20.7 19.2 19.3 23.1 Coefficient	Productivity 0.26 0.25 0.27 0.27	//Comp P
4 3 1 2 5 5 7 Serial 4 3 1 2 5	75 75 75 75 75 75 76 60 60 40 50 80	(KDSI (act) 70 60 40 50 80 MM (set) 283.1 240.8 325.7	CLE #3 (Rand Under (%) 20 40 50 10 30 265.8 235.4 148.1 163.1 323.5 (CLE #4 (Rand Under (%) )	RDSI (est) 56 36 36 45 56 87 74 48 61 100	DSIPTK, With MM (est) 223.9 140.8 76 178 223.9 MM(est) Q 23125 17420 11169 32350 DSIPTK, With MM (est)	th Underestimation TDEV (est) 19.5 16.4 13 17.9 19.5 sum MM(ect)*O: 23125 40545 47654 56823 91173	O*2 7588 5476 2304 3721 10000	MM (act) 285.8 235.4 148.1 183.1 323.5 sum C*2 7589 13045 15349 19070 29070	1DEV (act) 21.8 20.7 19.2 19.3 23.1 Coefficient 3.14	Productivity 0.26 0.25 0.27 0.27	//Comp P
4 3 1 2 5 70! Serial 4 3 1 2 5	75 75 75 75 75 75 70 60 40 50 80	(KDSI (act) 70 60 40 50 80 MM (ast) 283.1 240.8 157.3 198.8 325.7	CLE #3 (Raw Under (%) 20 40 50 10 30 265.8 235.4 148.1 183.1 323.5 CLE #4 (Raw Under (%)	8DSI (est) 56 36 20 45 56 87 74 48 61 100 80 Data, 75% KDSI (est) 42	DSIPTK, With MM (est) 76 178 223.9 140.8 76 178 223.9 140.8 76 178 223.9 140.8 76 178 223.9 140.8 76 178 223.9 178 235.0 1169 32350 159 159 159	## Underestimation ### 19.5 ##	O*2 7588 5476 2304 3721 10000	MM (act) 285.8 235.4 148.1 183.1 323.5 sum Q*2 7589 13045 15349 19070 29070	10EV (act) 21.8 20.7 19.2 19.3 23.1 Coefficient 3.14	Productivity 0.26 0.25 0.27 0.27	/Comp P
4 3 1 2 5 5 70 Serial 4 3 1 2 5 5	75 75 75 75 75 75 70 60 40 50 80	(KDSI (act) 70 60 40 50 80 80 80 283.1 240.8 157.3 198.8 325.7	(CLE #3 (Raw Under (%)) 20 40 50 10 30 265.8 285.8 285.4 148.1 183.1 323.5 (CLE #4 (Raw Under (%))	RDSI (est) 56 36 20 45 56 87 74 48 61 100  N Data, 75% KOSI (est) 42 28	DSIPTK, With MM (est) 140.8 76 178 223.9 MM(est) 70 23125 17420 7109 11169 32350 DSIPTK, With MM (est) 159 103.9	th Underestimation  **TOEV (est)**  19.5  16.4  13  17.9  19.5  sum MM(sct)**O:  23125  40545  47654  58823  91173  th Underestimation  **TOEV (est)**  17.2  14.6	O*2 7588 5476 2304 3721 10000	MM (sct) 285.8 235.4 148.1 183.1 323.5 sum CP2 7589 13045 15349 19070 29070	(IDEV (act) 21.8 20.7 19.2 19.3 23.1 Coefficient 3.14	Productivity 0.26 0.25 0.27 0.27	/Comp P
4 3 1 2 5 70 Serial 4 3 1 2 5	75 75 75 75 75 75 75 70 60 40 50 80	(KDSI (act) 70 60 40 50 80 WM (ast) 283.1 240.8 325.7 CV	CLE #3 (Ran (Vale #3) (Ran 20) 40 50 10 30 MM(act) 265.8 235.4 148.1 183.1 323.5 (CLE #4 (Ran Under (%) 40 30	RDSI (est) 56 36 36 45 56 87 74 48 61 100  N Data, 75% KDSI (est) 42 64	DSIPTK, With MM (est) 223.9 140.8 76 178 223.9 MM(est) Q 23125 17420 11169 32350 DSIPTK, With MM (est) 159 103.9 247.4	th Underestimation TDEV (est) 19.5 16.4 13 17.9 19.5 sum MM(ect)*Q: 23125 40545 47654 56823 91173 th Underestimation TDEV (est) 17.2 14.6 20.3	O*2 7588 5476 2304 3721 10000	MM (act) 284.8 143.1 1323.5 Sum CY2 7589 13045 15349 19070 29070	1DEV (act) 21.8 20.7 19.2 19.3 23.1  Coefficient 3.14  1DEV (act) 22.2 18.3 23.5	Productivity 0.26 0.25 0.27 0.27	/Comp P
4 3 1 2 5 5 FOI Seriel 4 3 1 2 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	75 75 75 75 75 75 76 60 60 40 50 80 DSIPTK (%) 75 75	(KDSI (act) 70 60 40 50 80 MM (ast) 283.1 240.8 157.3 198.8 325.7	CLE #3 (Raw (Value (%)) 20 40 50 10 30 MM(act) 285.8 235.4 148.1 183.1 323.5 (CLE #4 (Raw Under (%)) 40 30 20 50	ROSI (est) 56 36 20 45 56 87 74 48 61 100  ** Data, 75%  ROSI (est) 42 28 64 25	DSIPTK, With MM (est) 223.9 140.8 76 178 223.9 MM(est) 70.9 17420 7109 32350 DSIPTK, With (est) 159 103.9 247.4 92.2	th Underestimation TDEV (est) 19.5 16.4 13 17.9 19.5 sum MM(ect)*O: 23125 40545 47654 56823 91173 th Underestimation TDEV (est) 17.2 14.6 20.3 13.9	O*2 7588 5476 2304 3721 10000	MM (act) 285.8 235.4 148.1 183.1 323.5 sum O*2 7569 13045 15349 19070 29070 284.8 143 309.7 192.2	IDEV (act) 21.8 20.7 19.2 19.3 23.1 Coefficient 3.14 IDEV (act) 22.2 18.3 23.5 20.5	Productivity 0.26 0.25 0.27 0.27	/Comp P
4 3 1 2 5 70 Serial 4 3 1 2 5	75 75 75 75 75 75 75 70 60 40 50 80	(KDSI (act) 70 60 40 50 80 WM (ast) 283.1 240.8 325.7 CV	CLE #3 (Ran (Vale #3) (Ran 20) 40 50 10 30 MM(act) 265.8 235.4 148.1 183.1 323.5 (CLE #4 (Ran Under (%) 40 30	RDSI (est) 56 36 36 45 56 87 74 48 61 100  N Data, 75% KDSI (est) 42 64	DSIPTK, With MM (est) 223.9 140.8 76 178 223.9 MM(est) Q 23125 17420 11169 32350 DSIPTK, With MM (est) 159 103.9 247.4	th Underestimation TDEV (est) 19.5 16.4 13 17.9 19.5 sum MM(ect)*Q: 23125 40545 47654 56823 91173 th Underestimation TDEV (est) 17.2 14.6 20.3	O*2 7588 5476 2304 3721 10000	MM (act) 284.8 143.1 1323.5 Sum CY2 7589 13045 15349 19070 29070	1DEV (act) 21.8 20.7 19.2 19.3 23.1  Coefficient 3.14  1DEV (act) 22.2 18.3 23.5	Productivity 0.26 0.25 0.27 0.27	/Comp P
4 3 1 2 5 5 FOL Serial 4 3 1 1 2 2 5 5 FOL Serial 4 1 5 2 3 3	75 75 75 75 75 75 76 80 40 50 80 SSIPTK (%) 75 75 75	(KDSI (act) 70 60 80 80 1988 325.7	CLE #3 (Rand Control of Control o	ROSI (est) 56 36 20 45 56 87 74 48 61 100  ** Data, 75%  ROSI (est) 42 28 64 25	DSIPTK, With MM (est) 223.9 140.8 76 178 223.9 MM(est) 23125 17420 11169 32350 DSIPTK, With MM (est) 159 103.9 247.4 92.2 207	th Underestimation TDEV (est) 19.5 16.4 13 17.9 19.5 sum MM(ect)*Q 23125 40545 47654 58823 91173 th Underestimation TDEV (est) 17.2 14.6 20.3 13.9 19	O*2 7588 5476 2304 3721 10000	MM (act) 285.8 235.4 148.1 183.1 183.1 1323.5 Sum CP2 7569 13045 15349 19070 2	1DEV (act) 21.8 20.7 19.2 19.3 23.1  Coefficient 3.14  1DEV (act) 22.2 18.3 23.5 20.5 20.8	Productivit 0.26 0.25 0.27 0.27 0.25	/(Comp P
4 3 1 2 5 70 Serial 4 3 1 2 5 5	75 75 75 75 75 75 76 60 40 50 80 80 0 SIPTK (%) 75 75 75 75	(KDSI (act) 70 60 40 50 80 198.8 325.7 CV (KDSI (act) 70 40 80 60 60 MM (est)	CLE #3 (Raw 1 Under (%) 20 40 50 10 30 MM(act) 265.8 235.4 148.1 163.1 323.5 (CLE #4 (Raw Under (%) 40 30 50 10 10 10 10 10 10 10 10 10 1	KDSI (est) 56 36 36 45 56 87 74 48 61 100 KDSI (est) 42 28 64 25 54	DSIPTK, Wit MM (est) 223.9 140.8 76 178 223.9 MM(ect)*Q 23125 17420 7109 11169 32350 DSIPTK, Wit MM (est) 159 103.9 247.4 92.2 207 MM(ect)*Q Q Q Q Q Q Q Q Q Q Q Q Q Q Q Q Q Q Q	th Underestimation TDEV (est) 19.5 16.4 13 17.9 19.5 sum MM(ect)*O: 23125 40545 47654 56823 91173 th Underestimation TDEV (est) 17.2 14.6 20.3 13.9	722 7589 5476 2304 3721 10000	MM (act) 285.8 235.4 148.1 183.1 183.1 1323.5 Sum CP2 7569 13045 15349 19070 2	IDEV (act) 21.8 20.7 19.2 19.3 23.1 Coefficient 3.14 IDEV (act) 22.2 18.3 23.5 20.5	Productivity 0.25 0.27 0.27 0.25	0.26
4 3 1 2 5 5 70 Serial 4 3 1 2 5 5	75 75 75 75 75 75 76 80 40 50 80 SSIPTK (%) 75 75 75	(KDSI (act) 70 60 80 80 1988 325.7	CLE #3 (Rand Control of Control o	RDSI (est) 56 36 36 45 56 87 74 48 61 100  ** Data: 75%   KDSI (est) 42 28 64 25 54	DSIPTK, With MM (est) 223.9 140.8 76 178 223.9 MM(est) 23125 17420 11169 32350 DSIPTK, With MM (est) 159 103.9 247.4 92.2 207	th Underestimation TDEV (est) 19.5 16.4 13 17.9 19.5 sum MM(act)*O: 23125 40545 47654 56823 91173 th Underestimation TDEV (est) 17.2 14.6 20.3 13.9 19	C/2 7589 5476 2304 3721 10000	MM (act) 286.8 235.4 148.1 183.1 1823.5 13045 15349 19070 29	1DEV (act) 21.8 20.7 19.2 19.3 23.1  Coefficient 3.14  1DEV (act) 22.2 18.3 23.5 20.5 20.8	Productivit 0.26 0.25 0.27 0.27 0.25	0.26
4 3 1 2 5 5 FOI Seriel 4 3 1 2 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	75 75 75 75 75 75 76 60 40 50 80 80 80 90 75 75 75 75 75 75	(KDSI (act) 70 60 40 50 80 MM (ast) 283.1 240.8 157.3 198.8 325.7  (KDSI (act) 70 40 80 50 60 MM (ast) 271.8	CLE #3 (Raw Under (%) 20 40 50 10 30 285.8 235.4 148.1 183.1 323.5 CLE #4 (Raw Under (%) 40 30 Under (%) 40 50 10 30 10 10 10 10 10 10 10 10 10 1	ROSI (est) 56 36 20 45 56 87 74 48 61 100  ** Deta: 75% KOSI (est) 42 28 64 25 54	DSIPTK, Wit	## Underestimation ### 19.5 #### 19.5 ##### 19.5 ##### 19.5 ##### 19.5 ##### 19.5 ####################################	CP2 7589 5476 2304 3721 10000	MM (act) 265.8 235.4 148.1 183.1 183.1 323.5 sum Q*2 7569 13045 15349 19070 29070 284.8 143 309.7 192.2 216 sum C*2 7569	1DEV (act) 21.8 20.7 19.2 19.3 23.1  Coefficient 3.14  1DEV (act) 22.2 18.3 23.5 20.5 20.8	Productivity 0.25 0.25 0.27 0.25 0.25	0.26
4 3 1 2 5 70 Serial 4 3 1 2 5 5 70 Serial 4 1 5 2 3 70 Serial 4 1 5 2 5	75 75 75 75 75 75 76 80 80 80  DSIPTK (%) 75 75 75 75 75 75 75 75 75 75 76 KOSi (act) 70	(KDSI (act) 70 60 80 80 198.8 325.7 Ct KDSI (act) 70 80 60 60 60 60 60 60 60 60 60 60 60 60 60	(CLE #3 (Raw Under (%) 20 40 50 10 30 MM/(act) 285.8 235.4 148.1 183.1 323.5 (CLE #4 (Raw Under (%) 30 20 50 10 10 10 10 10 265.8 235.4 148.1 163.1 323.5	KOSI (est) 56 36 20 45 56 87 74 48 61 100  KOSI (est) 42 28 64 25 54  Q 87	DSIPTK, With MM (est) 140.8 76 140.8 76 178 223.9 MM(ect)*Q 23125 17420 7109 11169 32350 DSIPTK, With MM (est) 159 103.9 247.4 92.2 207 MM(ect)*Q 24778 6864	th Underestimation  **TDEV (est)**  19.5  16.4  13  17.9  19.5  sum MM(sct)**O:  23125  40545  47654  58623  91173  th Underestimation  TDEV:  14.6  20.3  13.9  19  sum MM(sct)**O:  24778  31642	CP2 7569 2304	MM (act) 285.8 235.4 148.1 183.1 323.5 sum CP2 7589 13045 15349 19070 29070 284.8 143 309.7 192.2 216 sum CP2 7569 9873	1DEV (act) 21.8 20.7 19.2 19.3 23.1  Coefficient 3.14  1DEV (act) 22.2 18.3 23.5 20.5 20.8	Productivity 0.25 0.25 0.25 0.25 0.25 0.25 0.25 0.25	//Comp P

Proj. Senet	DSIPTK (%)	KDSI (act)	Under (%)	KDSI (est)	MM (est)	TOEV (est)		MM (act)	TDEV (act)	1	
5	75	80	40	48	181.2	18		342.7	23		
4	75	70	10	63	241	20.1		264.3	20.8		
2	75	50	30	35	130	15.9		184.6	18.2		
3	75	60	50	30	110.6	14.9		243.4	20.2		
1	75	40	20	32	118.3	15.3		149.1	16.7		
roi.Senal	KDSI (act)	MM (est)	MM(act)	Q	MM(act)*Q	sum MM(act)*Q	0/2	sum Q^2	Coefficient	Productivity	Comp Pn
5	80	309.7	342.7	100	34270	34270	10000	10000		0.23	
4	70	269.2	264.3	87	22994	57264	7569	17569	•	0.26	
2	50	189.1	184.6	61	11261	68525	3721	21290		0.27	,
3	60	229	243.4	74	18012	86537	5476	26766		0.25	
1	40	149.6	149.1	48	7157	93694	2304	29070	3.22	0.27	0.253

	CYCLE #6 (Raw Data, 75% DSIPTK, With Underestimation)												
Proj Serie	DSIPTK (%)	KDSI (act)	Under (%)	KDSI (est)	MM (est)	TDEV (est)	1	MM (act)	TDEV (act)				
1	75	40	40	24	90.6	13.9	-	145.7	18.6				
2	75	50	20	40	154.9	17		178.7	19.1				
3	75	60	30	42	163	17.3		227.6	20.6				
4	75	70	50	35	134.6	16.1		298.4	22.3				
5	75	80	10	72	287.1	21.5		300.9	23.7				

Proj.Seria	KDSI (act)	MM (est)	MM(act)	Q	MM(act)*Q	sum MM(act)*Q	Q^2	sum Q^2	Coefficient	Productivity	Comp Prod
1	40	154.9	145.7	48	6994	6994	2304	2304		0.27	
2	50	195.8	178.7	61	10901	17895	3721	6025		0.28	
3	60	237.1	227.6	74	16842	34737	5476	11501		0.26	
4	70	278.7	298.4	87	25961	60698	7569	19070		0.23	
5	80	320.7	300.9	100	30090	90788	10000	29070	3.12	0.27	0.261

# APPENDIX K. NORMALIZATION CALIBRATION STRATEGY: UNDERSIZING - 75% DSIPTK

		CYC	LE #1 /Raw I	Deta, 75% DS	SIPTIC WAR	i i Indepedit	nation)					:
Day Carl	Table of the							ART - R	/			<del></del>
Prot Sedel	1 DSIPTK (%) 75	( ROSI (act)	Under (%)	KUSI (est)	67.5	TDEV (est)		144.7	TDEV (act) 20.2	ļ	<del></del>	<del>,</del>
2	75	50	20	40	115.4	15,2		181.2	20.9	<del></del>	<del></del> -	<del>-</del>
3	75	60	30	42	121.5	15.5	·	221.8	22.4	t	<del></del>	<del></del>
4	75	70	50	35	100.3	14.4		307.8	24.9		<del></del>	
5	75	80	10	72	214	19.2		289.8	25.1			
	KDSI (act)	LBI CON	MM(act)	MM(norm)		1 1 1 - NO	Laure Laure No.	0.2	618	e e e e e e e e	1	
PTOLSETER	40	115.4	144.7	137.2	- <u>C</u>	6586	sum MM(act)*Q 6586	2304	2304	Coemcian	Productivity 0.28	Comp Proc
2	5C	145.9	181.2	174.5	61	10645	17231	3721	6025	<del></del>	0.28	1
3	60	176,7	221.8	212.5	74	15725	32956	5476	11501	<del></del>	0.27	<del>,                                      </del>
4	70	207.8	307.8	251.4	87	21872	54828	7569	19070		0.23	1
5_	80	239	289.8	289	100	28900	83728	10000	29070	2.88	0.28	0.262
			<del></del>	<del></del>		<del></del> -	<u> </u>		<del></del>	<u> </u>	<del> </del>	<del></del>
			<del></del>	<del></del>		<del></del>	<del></del>		<del> </del>	<del></del>	<del> </del> -	
		CYCLE #	2 (Normaliz	ed Deta, 75%	DEIDTY V	Mith I bedere	etimetico)		-		<del> </del>	
							AN : 420/A1)					
ro Sena	DSIPTK (%)								TDEV (act)		ļ	
		50	40	30	102.4	14.5		188.7	20.6	ļ	<del></del>	<del></del>
1 3	75 75	40 60	10 20	36 48	124 167.8	15.6 17.5	<b></b>	137.6 220	18.1 21.3	├	<del></del>	
5	/3 	80	50	40	138.5	16.3	<del> </del>	370.7	24.6		<del></del>	<del></del>
4	75	70	30	49	171.4	17.7		275	22.8		<del>+</del>	<del></del>
												<u> </u>
Proj.Series	- एडा ट्य	MM (661)		174.4			10638	0.2	sum CP2	Coemcient	Productivity	Comp Prod
	St	175.1 138.5	188.7 137.6	137.1	61 48	10638 6581	17219	3721 2304	3721 6025		0.26	<del> </del>
<del>-</del>		212.1	220	212.7	74	15740	32959	5476	11501	<del></del>	0.27	<del></del> -
5~~	· 🚡 ·	286.8	370.7	294.6	100	29460	62419	10000	21501		0.22	<del>!</del>
4	n	249.3	275	252,4	87	21959	84378	7569	29070	2.9	0.25	0.252
<del></del>			<del></del>	,								
			<del>'</del>						<u> </u>	<u> </u>		<del></del>
		CYCLE	#3 (Norma	lized Data, 7	5% USIPTK	., With Unde	restimenco)				<del></del>	<del></del>
Pro Sere	(S)		Under (%)			TDEV (est)			TDEV (act)		1	<del></del>
		70	20	56	198.5	18.7		264.9	22.8		-	
3	75	60	40	36	124.9	15.7		235.8	21.7			
<u> </u>		40	50	20	67.4	12.4	LI	150	20.4		<del>;</del>	1
2	75	50 80	10	45 56	157.9 198.6	17.1		175.3	19.7			!
<u> </u>												
Proj Serie		~_	30	<del>  </del>		18.7	-	324.9	24.1	<del></del>	<del> </del>	<del> </del>
	KOS (ed-			1			sum MM(act)*O			Coefficient	Productivity	Como Prod
4	RDS (ed)	MM (est) 251		MM(norm) 252.4	Q 87		sum MM(act)*Q 21959			Coefficient	Productivity 0.26	Comp Prod
3	- 75 •0	MM (est) 251 213.5	MAM(ect) 264.9 235.8	MM(norm) 252.4 212.7	Q 87 74	AM(act)*0 21959 15740	21959 37699	Q^2 7589 5476	sum Q <sup>2</sup> 2 7569 13045	Coefficient	0.26	Comp Prod
3		MM (est) 251 213.5 139.5	MM(act) 264.9 236.8 150	252.4 212.7 137.2	Q 87 74 48	MM(act)*C 21959 15740 6586	21959 37699 44285	Q*2 7589 5476 2304	sum Q <sup>4</sup> 2 7569 13045 15349	Coefficient	0.26 0.25 0.27	Comp Prod
3 1 2	75 60 40 50	251 213.5 139.5 176.3	MM(act) 264.9 236.8 150 175.3	MM(norm) 252.4 212.7 137.2 174.2	Q 87 74 48 61	MM(act)*C 21959 15740 6586 10626	21959 37699 44285 54911	QA2 7589 5476 2304 3721	sum Q*2 7569 13045 15349 19070		0.26 0.25 0.27 0.29	
3		MM (est) 251 213.5 139.5	MM(act) 264.9 236.8 150	252.4 212.7 137.2	Q 87 74 48	MM(act)*C 21959 15740 6586	21959 37699 44285	Q*2 7589 5476 2304	sum Q <sup>4</sup> 2 7569 13045 15349	Coefficient	0.26 0.25 0.27	Comp Prod
3 1 2	75 60 40 50	251 213.5 139.5 176.3	MM(act) 264.9 236.8 150 175.3	MM(norm) 252.4 212.7 137.2 174.2	Q 87 74 48 61	MM(act)*C 21959 15740 6586 10626	21959 37699 44285 54911	QA2 7589 5476 2304 3721	sum Q*2 7569 13045 15349 19070		0.26 0.25 0.27 0.29	
3 1 2	75 60 40 50	251 213.5 139.5 176.3	MM(act) 264.9 236.8 150 175.3	MM(norm) 252.4 212.7 137.2 174.2	Q 87 74 48 61	MM(act)*C 21959 15740 6586 10626	21959 37699 44285 54911	QA2 7589 5476 2304 3721	sum Q*2 7569 13045 15349 19070		0.26 0.25 0.27 0.29	
3	75 60 40 50	251 251 213.5 139.5 176.3 286.8	MM(ect) 264.9 235.8 150 175.3 324.9	M.M(norm) 252.4 212.7 137.2 174.2 295.1	Q 87 74 48 61 100	MM(act)*C 21959 15740 6586 10626 29510	21959 37699 44285 54911 84421	QA2 7589 5476 2304 3721	sum Q*2 7569 13045 15349 19070		0.26 0.25 0.27 0.29	
3 1 2 5	75 80 40 50 80	251 251 213.5 139.5 176.3 288.8	MM(ect) 264.9 235.8 150 175.3 324.9	MM(norm) 252.4 212.7 137.2 174.2 295.1	Q 87 74 48 61 100	MM(ect)*C 21959 15740 6586 10626 29510	21959 37699 44285 54911 84421	QA2 7589 5476 2304 3721 10000	sum Q <sup>4</sup> 2 7569 13045 15349 19070 29070		0.26 0.25 0.27 0.29	
4 3 1 2 5	90 40 50 60	251 251 213.5 139.5 176.3 288.8 CYCLE	MM(ect) 264.9 235.8 175.3 324.9 84 (Norma	MM(norm) 252.4 212.7 137.2 174.2 295.1 szed Deta, 75	Q 87 74 48 61 100	MM(ect)*C 21959 15740 6586 10626 29510 	21959 37699 44285 54911 84421	Q*2 7589 5476 2304 3721 10000	sum Q <sup>2</sup> 2 7569 13045 15349 19070 29070		0.26 0.25 0.27 0.29	
3 1 2 5	75 60 40 50 80 80 1 DSSP1K (%)	MM (est) 251 213.5 139.5 176.3 288.8  CYCLE (KOSI (act)	MM(ect) 284.9 235.8 150 175.3 324.9 24 (Norma Under (%)	MM(norm) 252.4 212.7 137.2 174.2 295.1 2ed Data, 75 KDSI (est)	Q 87 74 48 61 100 5% DSIPTK MM (est) 146.8	MM(scb*C) 21989 21989 15740 6586 10826 29510 	21959 37699 44285 54911 84421	Q*2 7589 5476 2304 3721 10000 MM (act) 285.2	sum Q*2 7569 13045 15349 19070 29070		0.26 0.25 0.27 0.29	
4 3 1 2 5	90 40 50 60	251 251 213.5 139.5 176.3 288.8 CYCLE	MM(ect) 264.9 235.8 175.3 324.9 84 (Norma	MM(norm) 252.4 212.7 137.2 174.2 295.1 szed Deta, 75	Q 87 74 48 61 100	MM(ect)*C 21959 15740 6586 10626 29510 	21959 37699 44285 54911 84421	Q*2 7589 5476 2304 3721 10000	sum Q <sup>2</sup> 2 7569 13045 15349 19070 29070		0.26 0.25 0.27 0.29	
4 3 1 2 5 5 Proj Senal 4 1 1 5 2	75 60 50 80 80 75 75 75 75	MM (est) 251 213.5 139.5 176.3 288.8  CYCLE (KOSI (act) 76 40 50 50	150 175.3 150 175.3 324.9 24 (Norma Under (%) 40 30 20 50	255.1 KDSI (est) 42 28 64 25	Q 87 74 48 61 100 5% DSIPTK MM (est) 146,8 95,9 228,5 85,2	MM(sct)**© 21859 15740 6586 10826 29510 With Under IDEV (est) 16.6 14.2 19.7 13.5	21959 37699 44285 54911 84421	QA2 7589 5476 2304 3721 10000 MM (act) 285.2 142.4 194.2	sum Q <sup>2</sup> 2 7569 13045 15349 19070 29070 11DEV (act) 22.7 18.8 21.3		0.26 0.25 0.27 0.29	
4 3 1 2 5 5 Proj Sensi 4 1 1 5	75 60 40 50 60 60 1 DSSPTK (%) 75 75	MM (est) 251 213.5 139.5 176.3 288.8  CYCLE KOSI (act) 40 80	150 175.3 150 175.3 324.9 100 Under (%)	252.4 212.7 137.2 174.2 295.1 296.1 296.1 296.1 42 42 28	Q 87 74 48 61 100 5% DSIPTX MM (est) 146.8 95.9 228.5	MM(cc)**2 21959 15740 6586 10626 29510 	21959 37699 44285 54911 84421	Q*2 7589 5476 2304 3721 10000 MM (act) 285.2 142.4 312	sum Q <sup>2</sup> 2 7569 13045 15349 19070 29070 TDEV (act) 22.7 18.8 24.2		0.26 0.25 0.27 0.29	
Proj Serial  4 1 5 2 3 3 7 7 7 8 7 8 8 8 8 8 8 8 8 8 8 8 8 8	75 60 46 50 80 80 75 75 75 75	MMI (est) 251 213.5 139.5 176.3 288.8  CYCLE KOSI (act) 40 80 50 60	Wild (ed) 284.9 235.8 150 175.3 324.9 24 (Norma Under (%) 40 30 20 50	252.4 212.7 137.2 174.2 295.1 296.1 296.1 296.1 296.1 42 28 64 25 54	Q 87 74 48 61 100 5% DSIPTIN MM (est) 146,8 95,9 95,9 95,9 191,2	MM(cc)*C 21959 15740 6596 10626 29510 	21959 37699 44285 54911 84421	Q <sup>2</sup> 2 7589 5476 2304 3721 10000 MM (act) 285.2 142.4 312 194.2 214.5	SUM Q <sup>2</sup> 2 7569 13045 15349 19070 29070 10EV (sci) 22.7 18.8 24.2 21.3 21.4	29	0.26 0.25 0.27 0.29 0.25	0.261
Proj Senal 4 1 5 2 3 3 Proj Sertal	75 60 50 80 80 75 75 75 75 75 75	MM (est) 251 213.5 139.5 176.3 288.8  CYCLE KOSI (act)	WM/(cc) 284.9 235.8 150 175.3 324.9 84 (Norma Under (%) 40 30 50 10	MM(norm) 252.4 212.7 137.2 174.2 295.1  szed Data, 7: KDSI (est) 42 28 64 25 54	Q 87 74 48 61 100 5% DSIPTK MM (est) 146.8 95.9 928.5 85.2 191.2	MM(act)*C 21959 15740 6595 10026 29510 29510 29510 414.2 19.3 18.4 MM(act)*C 414.2 19.5 18.4	21959 37699 44285 54911 84421  restimation)	Q*2 7589 5476 2304 3721 10000 MM (act) 285.2 142.4 312 194.2 214.5	Sum Q*2 7569 13045 15349 19070 29070 22.7 18.8 24.2 21.3 21.4	29	0.26 0.25 0.27 0.29 0.25	0.261
Proj Serial  4 1 5 2 3 3 7 7 7 8 7 8 8 8 8 8 8 8 8 8 8 8 8 8	75 60 46 50 80 80 75 75 75 75	MMI (est) 251 213.5 139.5 176.3 288.8  CYCLE KOSI (act) 40 80 50 60	Wild (ed) 284.9 235.8 150 175.3 324.9 24 (Norma Under (%) 40 30 20 50	MM(norm) 252.4 212.7 137.2 174.2 295.1  Ezed Data, 75 KDSI (est) 42 28 64 225 54 MM(norm) 252.3	Q 87 74 48 61 100 5% DSIPTIN MM (est) 146,8 95,9 95,9 95,9 191,2	MM(cc)*C 21959 15740 6596 10626 29510 	21959 37699 44285 54911 84421	Q <sup>2</sup> 2 7589 5476 2304 3721 10000 MM (act) 285.2 142.4 312 194.2 214.5	sum Q*2 7569 13045 15349 19070 29070 217 10.8 24.2 21.3 21.4 sum Q*2 7569	29	0.26 0.25 0.27 0.29 0.25	0.261
4 3 1 2 5 5 5 5 5 6 6 6 6 6 6 6 6 6 6 6 6 6 6	75 40 50 60 60 75 75 75 75 75 75 76 77 78	MM (est) 251 213.5 139.5 176.3 286.8  CYCLE KOSI (ect) 70 40 80 50 60  MM (est) 251	WM/(cd) 284.9 235.8 150 175.3 324.9 24 (Norma Under (%) 40 30 20 50 10	252.4 212.7 137.2 174.2 295.1 296.1 296.1 296.1 296.1 42 28 64 25 54 25 54 26 37.7 37.7 37.7 37.7 37.7 37.7 37.7 37.	Q 87 74 48 61 100 5% DS/PTK MM (est) 146.8 95.9 228.5 85.2 191.2	MM(act)*2 21959 15740 6586 10626 29510 . With Under 15.6 14.2 19.7 13.5 18.4	21959 37699 44285 54911 84421  westimation)	0 <sup>2</sup> 2 7589 5476 2304 3721 10000 MM (act) 2852 1424 312 1942 214.5 CP2 7569	Sum Q*2 7569 13045 15349 19070 29070 22.7 18.8 24.2 21.3 21.4	29	0.26 0.25 0.27 0.29 0.25	0.261
4 3 1 2 5 5 Proj Sensi 4 1 5 2 3 Proj Sensi 4 4	75 40 50 60 60 75 75 75 75 75 75 77 77 70	MM (est) 251 213.5 139.5 176.3 288.8  CYCLE KOSI (act) 40 80 50 60  MM (est) 239.5 139.5	MM(ect) 284.9 235.8 150 175.3 324.9 40 40 30 20 50 10	MM(norm) 252.4 212.7 137.2 174.2 295.1  Exed Data, 75 KDSI (est) 42 28 64 225 54 MM(norm) 252.3	Q 87 74 48 61 100 5% DSIPTIK MAI (est) 146.8 95.9 95.9 95.2 191.2 Q 87 48	MM(cc)*C 21959 15740 6586 10828 29510 	21959 37699 44285 54911 84421 restimation)	Q*2 7589 5476 2304 3721 10000 MM (act) 285.2 142.4 312 194.2 214.5 Q*2 7569 2304	TDEV (act) 22.7 18.8 21.4 21.3 21.4 21.4 21.7 29.73	29	0.26 0.25 0.27 0.29 0.25	0.261

		CYCLE	#5 (Norme	ized Data, 7	5% DSIPTK	. With Unde	restimation)					
Pro Serial	DSPTK (%)	IOSI (act)	Under (%)	KDSI (est)	MM (est)	IDEV (call		MM (act)	TIDEV (GG)		-	
5	75	80	40	48	168.9	17.6		339.2	23.9		<del></del>	
4	75	70	10	63	224.8	19.6		256.7	23.1			
2	75	50	30	35	121.2	15.5		183.1	20.2			
3	75	60	50	30	103.1	14.6		241.5	22.2			
1	75	40	20	32	110.4	14.9	-	139.8	18.4			
Pro Serial	KOSI (act)	MM (cel)	MA(act)	MM(norm)	0	MM(ect)*C	sum MM(act)*Q	Q*2	sum CP2	Coefficient	Productivey	Comp Proc
5	80	288.8	339.2	296	100	29600	29600	10000	10000		0.24	
4	70	251	256.7	252.9	87	22002	51602	7589	17569		0.27	
2	50	176.3	183.1	174.4	61	10638	62240	3721	21290		0.27	
3	60	213.5	241.5	212.6	74	15732	77972	5476	26766		0.25	
1	40	139.5	139.8	137.1	48	6581	84563	2304	29070	2.91	0.29	0.259
		CYCLE	#6 (Norma	itzed Data, 7	5% DSIPTK	, With Unde	restimation)					
Pro Serie	DSIPTK (%)	(0S) (0d)	Under (%)	KUSI (est)	MM (est)	TDEV (est		MM (act)	TDEV (CCO			
. 1	75	40	40	24	81.9	13.3		146.2	19.4		<del></del>	
2	75	50	20	40	140	16.3		178.5	19.8			
3	75	60	30	42	147.3	16.7		227.8	21.5			
4	75	70	50	35	121.7	15.5		294.7	23.1			
5	75	80	10	72	259.5	20.7	•	301.7	24.6		-	
Proj.Seriel	KDSI (act)	MM (est)	MM(act)	MM(norm)	Q	MM(act)*C	sum MM(act)*Q	Q*2	sum C^2	Commisent	Productivity	Comp Prod
1	40	140	146.2		48			2304	2304		0.27	
2	50	176.9	178.5	•	61	•	•	3721	6025	•	0.28	
3	60	214.3	227.8	•	74		•	5476	11501	•	0.26	
4	70	251.9	294.7	•	87		•	7569	19070	•	0.24	
-5	80	289.8	301.7		100			10000	29070		0.27	0.261

#### APPENDIX L. NORMALIZATION DATA: UNDERSIZING - 75% DSIPTK

	YCLE #1,	PROJECT	#1	C	CYCLE #1, PROJECT #2					
KDSI (est)	TDEV (est)	MM (est)	MM (act)	KDSI (est)	TDEV (est)	MM (est)	MM (act)			
40	20.2	144.7	144.6	50	20.9	181.2	180.9			
40	20.2	135	137.5	50	20.9	170	174.6			
40	20.2	130	137.2	50	20.9	165	374.5			
40	20.2	125	137.4	50	20.9	160	174.8			
40	20.2	120	138.9							
<u></u>										
C	YCLE #1,	PROJECT	#3	C	YCLE #1, I	PROJECT	#4			
KDSI (est)	TDEV (est)	MM (est)	MM (act)	KDSI (est)	TDEV (est)	MM (est)	MM (act)			
60	22.4	221.8	221.1	70	24.9	307.8	296.1			
60	22.4	210	212.5	70	24.9	300	292.1			
60	22.4	208	212.5	70	24.3	290	285.8			
60	22.4	205	212.5	70	24.9	280	278.2			
60	22.4	200	212.8	70	24.9	270	268.9			
	<b> </b>			70	24.9	260	259.4			
	ļ			70	24.9	250	251.4			
<u> </u>	<u> </u>			70	24.9	245	251.4			
ļ				70	24.9	240	252			
	YCLE #1, I				YCLE #2, I					
	TDEV (est)		MM (act)		TDEV (est)		MM (act)			
- AA			294.2	50	20.6	1997				
80	25.1	289.8				188.7	188.3			
80	25.1	265	298.7	50	20.6	180	179.6			
80 80	25.1 25.1	265 255	298.7 300.4	50 50	20.6 20.6	180 170	179.6 174.6			
80 80 80	25.1 25.1 25.1	265 255 245	298.7 300.4 298.4	50 50 50	20.6 20.6 20.6	180 170 165	179.6 174.6 174.5			
80 80 80 80	25.1 25.1 25.1 25.1 25.1	265 255 245 230	298.7 300.4 298.4 290.4	50 50 50 50	20.6 20.6 20.6 20.6	180 170 165 163	179.6 174.6 174.5			
80 80 80 80 80	25.1 25.1 25.1 25.1 25.1	265 255 245 230 225	298.7 300.4 298.4 290.4	50 50 50	20.6 20.6 20.6	180 170 165	179.6 174.6 174.5			
80 80 80 80 80	25.1 25.1 25.1 25.1 25.1 25.1	265 255 245 230 225 220	298.7 300.4 298.4 290.4 289. 289.1	50 50 50 50	20.6 20.6 20.6 20.6	180 170 165 163	179.6 174.6 174.5			
80 80 80 80 80	25.1 25.1 25.1 25.1 25.1	265 255 245 230 225	298.7 300.4 298.4 290.4	50 50 50 50	20.6 20.6 20.6 20.6	180 170 165 163	179.6 174.6 174.5			
80 80 80 80 80 80	25.1 25.1 25.1 25.1 25.1 25.1 25.1	265 255 245 230 225 220 215	298.7 300.4 298.4 290.4 289. 289.1 290.9	50 50 50 50	20.6 20.6 20.6 20.6	180 170 165 163	179.6 174.6 174.5			
80 80 80 80 80 80 80 80	25.1 25.1 25.1 25.1 25.1 25.1 25.1	265 255 245 230 225 220 215 210	298.7 300.4 298.4 290.4 289 289.1 290.9 292.6	50 50 50 50 50	20.6 20.6 20.6 20.6	180 170 165 163 160	179.6 174.6 174.5 374.4 174.5			
80 80 80 80 80 80 80	25.1 25.1 25.1 25.1 25.1 25.1 25.1 25.1	265 255 245 230 225 220 215 210 PROJECT MM (est)	298.7 300.4 298.4 290.4 289 289.1 290.9 292.6	50 50 50 50 50	20.6 20.6 20.6 20.6 20.6 20.6	180 170 165 163 160 PROJECT	179.6 174.6 174.5 374.4 174.5			
80 80 80 80 80 80 80	25.1 25.1 25.1 25.1 25.1 25.1 25.1 25.1	265 255 245 230 225 220 215 210 PROJECT MM (est) 137.6	298.7 300.4 298.4 290.4 289.1 290.9 292.6 #1	50 50 50 50 50	20.6 20.6 20.6 20.6 20.6 20.6 YCLE #2, I	180 170 165 163 160 PROJECT	#3 MM (act) 219.8			
80 80 80 80 80 80 80 80 KDS1 (est) 40	25.1 25.1 25.1 25.1 25.1 25.1 25.1 25.1	265 255 245 230 225 220 215 210 PROJECT MM (est) 137.6	298.7 300.4 298.4 290.4 289. 289.1 290.9 292.6 #1 MM (act) 137.5	50 50 50 50 50 50 50 50 60	20.6 20.6 20.6 20.6 20.6 20.6 YCLE #2, TDEV (est) 21.3 21.3	180 170 165 163 160 PROJECT MM (est) 220 205	#3 MM (act) 219.8 212.8			
80 80 80 80 80 80 80 80 KDSI (est) 40 40	25.1 25.1 25.1 25.1 25.1 25.1 25.1 25.1	265 255 245 230 225 220 215 210 PROJECT MM (est) 137.6 135 130	298.7 300.4 298.4 290.4 289. 289.1 290.9 292.6 #1 MM (act) 137.5 137.5	50 50 50 50 50 50 50 60 60 60 60	20.6 20.6 20.6 20.6 20.6 20.6 YCLE #2, TDEV (est) 21.3 21.3 21.3	180 170 165 163 160 PROJECT MM (est) 220 205 200	#3 MM (act) 219.8 212.8			
80 80 80 80 80 80 80 80 80 KDSI (est) 40 40	25.1 25.1 25.1 25.1 25.1 25.1 25.1 25.1	265 255 245 230 225 220 215 210 PROJECT MM (est) 137.6 135 130 128	298.7 300.4 298.4 290.4 289. 289.1 290.9 292.6 #1 MM (act) 137.5 137.1 137.2	50 50 50 50 50 50 50 60 60 60 60 60	20.6 20.6 20.6 20.6 20.6 20.6 YCLE #2, TDEV (est) 21.3 21.3 21.3 21.3	180 170 165 163 160 PROJECT MM (est) 220 205 200 195	#3 MM (act) 219.8 212.9			
80 80 80 80 80 80 80 80 80 40 40 40 40	25.1 25.1 25.1 25.1 25.1 25.1 25.1 25.1	265 255 245 230 225 220 215 210 PROJECT MM (est) 137.6 135 130 128 125	298.7 300.4 298.4 290.4 289. 289.1 290.9 292.6 #1 MM (act) 137.5 137.1 137.2 137.1	50 50 50 50 50 50 50 60 60 60 60 60 60	20.6 20.6 20.6 20.6 20.6 20.6 YCLE #2, TDEV (est) 21.3 21.3 21.3 21.3 21.3	180 170 165 163 160 PROJECT MM (est) 220 205 200 195 190	#3 MM (act) 219.8 212.9 213.8			
80 80 80 80 80 80 80 80 80 KDSI (est) 40 40	25.1 25.1 25.1 25.1 25.1 25.1 25.1 25.1	265 255 245 230 225 220 215 210 PROJECT MM (est) 137.6 135 130 128	298.7 300.4 298.4 290.4 289. 289.1 290.9 292.6 #1 MM (act) 137.5 137.1 137.2	50 50 50 50 50 50 50 60 60 60 60 60	20.6 20.6 20.6 20.6 20.6 20.6 YCLE #2, TDEV (est) 21.3 21.3 21.3 21.3	180 170 165 163 160 PROJECT MM (est) 220 205 200 195	#3 MM (act) 219.8 212.9			
80 80 80 80 80 80 80 80 80 KDSI (est) 40 40 40	25.1 25.1 25.1 25.1 25.1 25.1 25.1 25.1	265 255 245 230 225 220 215 210 PROJECT MM (est) 137.6 135 130 128 125	298.7 300.4 298.4 290.4 289. 289.1 290.9 292.6 #1 MM (act) 137.5 137.1 137.2 137.1	50 50 50 50 50 50 50 60 60 60 60 60 60	20.6 20.6 20.6 20.6 20.6 20.6 YCLE #2, TDEV (est) 21.3 21.3 21.3 21.3 21.3	180 170 165 163 160 PROJECT MM (est) 220 205 200 195 190	#3 MM (act) 219.8 212.9 213.8			

C	YCLE #2, F	PROJECT	#5	<u> </u>	C	YCLE #2, F	PROJECT	#4
KDSI (est)	TDEV (est)	MM (est)	MM (act)		KDSI (est)	TDEV (est)	MM (est)	MM (act)
80	24.6	370.7	354		70	22.8	275	273.9
80	24.6	350	342.6		70	22.8	265	264.4
80	24.6	330	327.7		70	22.8	255	254.4
80	24.6	310	309.2		70	22.8	245	252.8
80	24.6	290	295.3		70	22.8	240	252.7
80	24.6	285	295		70	22.8	235	252.4
80	24.6	280	294.6		70	22.8	230	253.6
80	24.6	270	296.8		70	22.8	225	255.4

C	CYCLE #3, PROJECT #4			 CYCLE #3, PROJECT #3				
CDSI (est)	TDEV (est)	MM (est)	MM (act)	 KDSI (est)	TDEV (est)	MM (est)	MM (act)	
70	22.8	264.9	264.3	 60	21.7	235.8	234.7	
70	22.8	245	252.8	 60	21.7	220	219.5	
70	22.8	240	252.7	 60	21.7	210	212.8	
70	22.8	235	252.4	 60	21.7	205	212.8	
70	22.8	230	253.6	 60	21.7	200	212.7	
70	22.8	225	255.4	 60	21.7	195	213	
70	22.8	220	256.7	 60	21.7	190	214.2	
	-			60	21.7	180	216.8	

С	YCLE #3, F	PROJECT	#1	 CYCLE #3, PROJECT #2					
KDSI (est)	TDEV (est)	MM (est)	MM (act)	KDSI (est)	TDEV (est)	MM (est)	MM (act)		
40	20.4	150	149.6	50	19.7	175.3	174.9		
40	20.4	135	137.5	 50	19.7	170	174.5		
40	20.4	130	137.2	50	19.7	165	174.2		
40	20.4	125	137.7	 50	19.7	160	174.4		
40	20 4	120	139.1	50	19.7	155	175		
				50	19.7	150	176.7		
	<del></del>			 			<del></del>		

C,	YCLE #3, F	PROJECT	#5	 CYCLE #4, PROJECT #4			
KDSI (est)	TDEV (est)	MM (est)	MM (act)	 KDSI (est)	TDEV (est)	MM (est)	MM (act)
80	24.1	324.9	323.7	70	22.7	285.2	279.8
80	24.1	300	299.5	70	22.7	260	259.6
30	24.1	285	295.5	70	22.7	245	252.4
80	24.1	280	295.1	70	22.7	240	252.3
80	24.1	275	295.5	70	22.7	235	252.6
80	24.1	270	297.1	70	22.7	230	253.8
80	24.1	265	298.5	70	22.7	225	255.7
80	24.1	260	299.7	70	22.7	220	257.2

С	YCLE #4, F	PROJECT	#1		CYCLE #4, F	PROJECT	#5
KDSI (est)	TDEV (est)	MM (est)	MM (act)	KDSI (est	) TDEV (est)	MM (est)	MM (act
40	18.8	142.4	144.3	80	24.2	312	311.1
40	18.8	135	137.3	80	24.2	290	295.2
40	18.8	132.5	137.4	80	24.2	285	295
40	18.8	130	137.3	80	24.2	280	294.6
40	18.8	125	137.4	80	24.2	275	295.7
40	18.8	120	138.3	80	24.2	270	296.9
C	YCLE #4, F	PROJECT	#2		CYCLE #4, F	PROJECT	#3
	TDEV (est)		MM (act)		) TDEV (est)		MM (act)
50	21.3	194.2	191.1	60	21.4	214.5	215.5
50	21.3	180	179.6	60	21.4	210	212.8
50	21.3	175	174.6	60	21.4	207.5	212.8
50	21.3	170	174.3	60	21.4	205	212.4
50	21.3	165	174.5	60	21.4	200	212.7
50	21.3	160	174.8	60	21.4	195	213
50	21.3	155	176.4	60	21.4	190	214.2
50	21.3	150	178.2	60	21.4	185	216.1
				60	21.4	180	216.8
				- 00	21.4	100	210.6
	VOLE #5 1	DO IFOT	46				i
	YCLE #5, F				CYCLE #5, F	PROJECT	#4
KDSI (est)	TDEV (est)	MM (est)	MM (act)	(KDSI (est	CYCLE #5, F	PROJECT	#4 MM (act)
KDSI (est) 80	TDEV (est) 23.9	MM (est) 339.2	MM (act) 337.6	KDSI (est	CYCLE #5, F ) TDEV (est) 23.1	PROJECT MM (est) 256.7	#4 MM (act) 256.9
KDSI (est) 80 80	7DEV (est) 23.9 23.9	MM (est) 339.2 320	MM (act) 337.6 319	KDSI (est 70 70	CYCLE #5, F ) TDEV (est) 23.1 23.1	PROJECT MM (est) 256.7 240	#4 MM (act) 256.9 253.2
KDSI (est) 80 80 80	23.9 23.9 23.9 23.9	MM (est) 339.2 320 300	MM (act) 337.6 319 299.7	KDSI (est 70 70 70	CYCLE #5, F ) TDEV (est) 23.1 23.1 23.1	PROJECT MM (est) 256.7 240 235	#4 MM (act) 256.9 253.2 252.9
80 80 80 80 80	7DEV (est) 23.9 23.9 23.9 23.9 23.9	MM (est) 339.2 320 300 285	MM (act) 337.6 319 299.7 296	KDSI (est 70 70 70 70 70	CYCLE #5, F ) TDEV (est) 23.1 23.1 23.1 23.1	PROJECT MM (est) 256.7 240 235 230	#4 MM (act) 256.9 253.2 252.9 253.6
80 80 80 80 80 80	23.9 23.9 23.9 23.9 23.9 23.9 23.9	MM (est) 339.2 320 300 285 282.5	MM (act) 337.6 319 299.7 296 296.2	KDSI (est 70 70 70 70 70 70	CYCLE #5, F ) TDEV (est) 23.1 23.1 23.1 23.1 23.1 23.1	PROJECT MM (est) 256.7 240 235 230 225	#4 MM (act) 256.9 253.2 252.9 253.6 255.2
80 80 80 80 80 80 80	TDEV (est) 23.9 23.9 23.9 23.9 23.9 23.9 23.9 23.9	MM (est) 339.2 320 300 285 282.5 280	MM (act) 337.6 319 299.7 296. 296.2 296.3	KDSI (est 70 70 70 70 70	CYCLE #5, F ) TDEV (est) 23.1 23.1 23.1 23.1	PROJECT MM (est) 256.7 240 235 230	#4 MM (act) 256.9 253.2 252.9 253.6
80 80 80 80 80 80 80 80	TDEV (est) 23.9 23.9 23.9 23.9 23.9 23.9 23.9 23.9	MM (est) 339.2 320 300 285 282.5 280 275	MM (act) 337.6 319 299.7 296. 296.2 296.3 296.4	KDSI (est 70 70 70 70 70 70	CYCLE #5, F ) TDEV (est) 23.1 23.1 23.1 23.1 23.1 23.1	PROJECT MM (est) 256.7 240 235 230 225	#4 MM (act) 256.9 253.2 252.9 253.6 255.2
KDSI (est) 80 80 80 80 80 80 80 80	TDEV (est) 23.9 23.9 23.9 23.9 23.9 23.9 23.9 23.9	MM (est) 339.2 320 300 285 282.5 280 275 270	MM (act) 337.6 319 299.7 296 296.2 296.3 296.4 297.4	KDSI (est 70 70 70 70 70 70	CYCLE #5, F ) TDEV (est) 23.1 23.1 23.1 23.1 23.1 23.1	PROJECT MM (est) 256.7 240 235 230 225	#4 MM (act) 256.9 253.2 252.9 253.6 255.2
80 80 80 80 80 80 80 80	TDEV (est) 23.9 23.9 23.9 23.9 23.9 23.9 23.9 23.9	MM (est) 339.2 320 300 285 282.5 280 275	MM (act) 337.6 319 299.7 296. 296.2 296.3 296.4	KDSI (est 70 70 70 70 70 70	CYCLE #5, F ) TDEV (est) 23.1 23.1 23.1 23.1 23.1 23.1	PROJECT MM (est) 256.7 240 235 230 225	#4 MM (act) 256.9 253.2 252.9 253.6 255.2
KDSI (est) 80 80 80 80 80 80 80 80	TDEV (est) 23.9 23.9 23.9 23.9 23.9 23.9 23.9 23.9	MM (est) 339.2 320 300 285 282.5 280 275 270 260	MM (act) 337.6 319 299.7 296.2 296.2 296.3 296.4 297.4 300	(C) KDSI (est 70 70 70 70 70 70 70 70	CYCLE #5, F ) TDEV (est) 23.1 23.1 23.1 23.1 23.1 23.1 23.1	PROJECT MM (est) 256.7 240 235 230 225 220	#4 MM (act) 256.9 253.2 252.9 253.6 255.2 256.4
KDSI (est) 80 80 80 80 80 80 80 80 80	TDEV (est) 23.9 23.9 23.9 23.9 23.9 23.9 23.9 23.9	MM (est) 339.2 320 300 285 282.5 280 275 270 260  PROJECT	MM (act) 337.6 319 299.7 296 296.2 296.3 296.4 297.4 300	(KDSI (est 70 70 70 70 70 70 70	CYCLE #5, F ) TDEV (est) 23.1 23.1 23.1 23.1 23.1 23.1 CYCLE #5, F	PROJECT MM (est) 256.7 240 235 230 225 220  PROJECT	#4 MM (act) 256.9 253.2 252.9 253.6 255.2 256.4
KDSI (est) 80 80 80 80 80 80 80 80 80 80 KDSI (est)	TDEV (est) 23.9 23.9 23.9 23.9 23.9 23.9 23.9 23.9	MM (est) 339.2 320 300 285 282.5 280 275 270 260  PROJECT MM (est)	MM (act) 337.6 319 299.7 296 296.2 296.3 296.4 297.4 300 #2 MM (act)	(KDSI (est 70 70 70 70 70 70 70 70 KDSI (est KDSI (est 80	CYCLE #5, F ) TDEV (est) 23.1 23.1 23.1 23.1 23.1 23.1 CYCLE #5, F	PROJECT  MM (est)  256.7  240  235  230  225  220  PROJECT  MM (est)	#4 MM (act) 256.9 253.2 252.9 253.6 255.2 256.4
KDSI (est) 80 80 80 80 80 80 80 80 80 C KDSI (est)	TDEV (est) 23.9 23.9 23.9 23.9 23.9 23.9 23.9 23.9	MM (est) 339.2 320 300 285 282.5 280 275 270 260  PROJECT MM (est) 183.1	MM (act) 337.6 319 299.7 296. 296.2 296.3 296.4 297.4 300 #2 MM (act) 182.6	(KDSI (est 70 70 70 70 70 70 70 70 70 KDSI (est 60 KDSI (	CYCLE #5, F ) TDEV (est) 23.1 23.1 23.1 23.1 23.1 23.1  CYCLE #5, F	PROJECT MM (est) 256.7 240 235 230 225 220  PROJECT MM (est) 241.5	#4 MM (act) 256.9 253.2 252.9 253.6 255.2 256.4 #3 MM (act) 239.4
KDSI (est) 80 80 80 80 80 80 80 80 80 C KDSI (est)	TDEV (est) 23.9 23.9 23.9 23.9 23.9 23.9 23.9 23.9	MM (est) 339.2 320 300 285 282.5 280 275 270 260  PROJECT MM (est) 183.1 170	MM (act) 337.6 319 299.7 296. 296.2 296.3 296.4 297.4 300  #2  MM (act) 182.6 174.9	KDSI (est 70 70 70 70 70 70 70 70 70 70 70 70 70	CYCLE #5, F ) TDEV (est) 23.1 23.1 23.1 23.1 23.1 23.1 23.1 23.1	PROJECT MM (est) 256.7 240 235 230 225 220  PROJECT MM (est) 241.5 220	#4 MM (act) 256.9 253.2 252.9 253.6 255.2 256.4 #3 MM (act) 239.4 219.4
KDSI (est) 80 80 80 80 80 80 80 80 80 60 80 80 80 80 80 80 80 80 50 50	TDEV (est) 23.9 23.9 23.9 23.9 23.9 23.9 23.9 23.9	MM (est) 339.2 320 300 285 282.5 280 275 270 260  PROJECT MM (est) 183.1 170 165	MM (act) 337.6 319 299.7 296. 296.2 296.3 296.4 297.4 300  #2  MM (act) 182.6 174.9 174.7	KDSI (est 70 70 70 70 70 70 70 70 70 70 70 70 70	CYCLE #5, F ) TDEV (est) 23.1 23.1 23.1 23.1 23.1 23.1 23.1 23.1	PROJECT MM (est) 256.7 240 235 230 225 220  PROJECT MM (est) 241.5 220 205	#4 MM (act) 256.9 253.2 252.9 253.6 255.2 256.4 #3 MM (act) 239.4 219.4 212.8
KDSI (est) 80 80 80 80 80 80 80 80 80 60 60 80 80 80 80 80 50 50 50	TDEV (est) 23.9 23.9 23.9 23.9 23.9 23.9 23.9 23.9	MM (est) 339.2 320 300 285 282.5 280 275 270 260  PROJECT MM (est) 183.1 170 165 160	MM (act) 337.6 319 299.7 296.2 296.2 296.3 296.4 297.4 300 #2 MM (act) 182.6 174.9 174.7	KDSI (est 70 70 70 70 70 70 70 70 70 70 70 70 70	CYCLE #5, F ) TDEV (est) 23.1 23.1 23.1 23.1 23.1 23.1 23.1 23.1	PROJECT MM (est) 256.7 240 235 230 225 220  PROJECT MM (est) 241.5 220 205 200	#4 MM (act 256.9 253.2 252.9 253.6 255.2 256.4  #3 MM (act) 239.4 219.4 212.8 212.6
KDSI (est) 80 80 80 80 80 80 80 80 80 80 60 50 50 50	TDEV (est) 23.9 23.9 23.9 23.9 23.9 23.9 23.9 23.9	MM (est) 339.2 320 300 285 282.5 280 275 270 260  PROJECT MM (est) 183.1 170 165 160 155	MM (act) 337.6 319 299.7 296.2 296.2 296.3 296.4 297.4 300 #2 MM (act) 182.6 174.9 174.7 174.4	KDSI (est 70 70 70 70 70 70 70 70 70 70 70 70 70	CYCLE #5, F ) TDEV (est) 23.1 23.1 23.1 23.1 23.1 23.1 23.1 23.1	PROJECT MM (est) 256.7 240 235 230 225 220  PROJECT MM (est) 241.5 220 205 200 195	#4 MM (act 256.9 253.2 252.9 253.6 255.2 256.4  #3 MM (act) 239.4 212.8 212.6 213
KDSI (est) 80 80 80 80 80 80 80 80 80 60 60 80 80 80 80 80 50 50 50	TDEV (est) 23.9 23.9 23.9 23.9 23.9 23.9 23.9 23.9	MM (est) 339.2 320 300 285 282.5 280 275 270 260  PROJECT MM (est) 183.1 170 165 160	MM (act) 337.6 319 299.7 296.2 296.2 296.3 296.4 297.4 300 #2 MM (act) 182.6 174.9 174.7	KDSI (est 70 70 70 70 70 70 70 70 70 70 70 70 70	CYCLE #5, F ) TDEV (est) 23.1 23.1 23.1 23.1 23.1 23.1 23.1 23.1	PROJECT MM (est) 256.7 240 235 230 225 220  PROJECT MM (est) 241.5 220 205 200	#4 MM (act 256.9 253.2 252.9 253.6 255.2 256.4   #3 MM (act 239.4 219.4 212.8 212.6

CYCLE #5, PROJECT #1											
KDSI (est)	TDEV (est)	MM (est)	MM (act)								
40	18.4	139.8	138.8								
40	16.3	130	137.1								
40	16.3	127.5	137.2								
40	16.3	125	137.1								
40	16.3	120	137.5								
40	16.3	115	139								
40	16.3	110	139.8								

# APPENDIX M. CONVENTIONAL CALIBRATION STRATEGY: UNDERSIZING - 125% DSIPTK

						ith Underestimati	OF1)			<u> </u>	
Proj.Seriel	DSPTK (%)				MM (est)	TDEV (est)			TDEV (act)		
1	125	40	40	24	67.5	12.4		109.5	17.1		
2	125	50	20	40	115.4	15.2		138.2	17.4	[	
3	125	60	30 50	42	121.5	15.5		169	18.4	<b> </b>	<del></del>
5	125 125	70 80	10	35	100.3	14.4		230.9	20.3	<del> </del>	
3	၂ဩ	- 80	10	72	214	19.2		224.1	20.5	ļ	
Dani Carial	KOSI (act)	MA (cet)	MA (act)	Q	NAME OF THE OWN	sum MM(act)*Q	Q*2	#1100 CM2	Coefficient	Onne which	Corns Day
1	40	115.4	109.5	48	5256	5256	2304	2304	- Comment	0.37	COMP FIG
2	50	145.9	138.2	61	8430	13686	3721	6025	<del> </del>	0.36	
3	60	176.7	169	74	12506	26192	5476	11501	<del> </del>	0.36	
4	70	207.8	230.9	87	20068	46280	7569	19070	<del>                                     </del>	0.3	
5	80	239	224.1	100	22410	68690	10000	29070	2.36	0.36	0.344
	1							i			
	[	CY	CLE #2 (Raw	Deta, 125%	DSIPTK, W	ith Underestimati	on)		:		
Proj Serial	DSIPTK (%)					TDEV (est)			TDEV (act)		
2	125	50	40	30	83.9	13.5		140.2	18.1		
	125	40	10	36	101.6	14.5	ļ <u>.</u>	108.5	16.3	ļ	
3	125	60	20	48	137.5	16.2		164.2	18.3	L	
5	125	80	50	40	113.5	15.1		280.7	21.2	<b> </b>	
4	125	70	30	49	140.5	16.4		202.4	19.5	ļ	
omi Carial	KDSI (act)	V4 /	MM(act)	- Q	LEVENBA	sum MM(act)*Q	Q*2	SIND CAS	Coefficient	Denote of the	Come D
2	50	143.5	140.2	61	8552	8552	3721	3721	COGNICANA	0.36	Comp Pro
1	40	113.5	108.5	48	5208	13760	2304	6025	<del></del>	0.37	
3	60	173.8	164.2	74	12151	25911	5476	11501	<del> </del>	0.37	
5	80	235	280.7	100	28070	53981	10000	21501	<del> </del>	0.31	
4	70	204.3	202.4	87	17909	71590	7569	29070	2.46	0.35	0.335
		CY	CLE #3 (Raw	Data, 125%	DSIPTK, W	ith Underestimeti	ion)		!		
	DSIPTK (%)					TDEV (est)			TDEV (act)		
4	125	70	20	56	168.5	17.5		201	19.3	<b></b>	
3	125 125	60 40	40 50	36	105.9 57.2	14.7 11.6		175.8	18.5	ļ	
-1-	125	50	10	20 45	133.9	16.1	ļ	112.7 142.5	17.7	<b></b>	
- 5	125	80	30	56	168.5	17.5		240	17.6 20.2	f	
	120	<del> </del>	<del>- 3</del> -	30	100.5	17.5		240	20.2	<del></del>	
Seriel	KDSI (ect)	ABJ (ast)	MANAGE	0	Maria	sum MM(act)*Q	0.5	SIMO OVO	Coefficient	Denot articular	Corne De
4	70	213	201	87	17487	17487	7569	7569	A COLUMN TO A COLU	0.35	
3	60	181.1	175.8	74	13009	30496	5476	13045	<del>                                     </del>	0.34	
1	40	118.3	112.7	74	8340	38836	5476	18521	1	0.35	
2	50	149.6	142.5	61	8693	47529	3721	22242	1	0.35	
5	80	245	240	100	24000	71529	10000	32242	2.22	0.33	0.344
									<u> </u>		
		CY	CLE #4 (Raw	Data, 125%	DSIPTK, W	ith Underestimati	on)		i		
		KDSI (act)							TDEV (act)		
roj.Senal	DSIPTK (%)		40	42	112.4	15		218	20.3		
4	125	70				12.8		104.6	16.9	t	
4	125 125	40	30	28	73.4						
1 5	125 125 125	40 80	30 20	64	174.9	17.8		228.4	20.9		
1 5 2	125 125 125 125	40 80 50	30 20 50	64 25	174.9 65.2	17.8 12.2		146.7	19.4		
4 1 5	125 125 125	40 80	30 20	64	174.9	17.8	<b>&gt;</b>				
4 1 5 2 3 Proj. Serial	125 125 125 125 125 126 KOSi (act)	40 80 50 60 MM (est)	30 20 50 10 MM(act)	64 25 54 Q	174.9 65.2 146.3 MM(act)*Q	17.8 12.2 16.6 sum MM(act)*Q		146.7 157.6 sum Q^2	19.4		Comp Pri
4 1 5 2 3 Proj. Serial	125 125 125 125 125 125 125 KDSi (act)	40 80 50 60 MM (est) 192.2	30 20 50 10 MM(act) 218	64 25 54 Q 87	174.9 65.2 146.3 MM(act)*Q 18966	17.8 12.2 16.6 sum MM(act)*Q 18966	7569	146.7 157.6 sum Q^2 7569	19.4 18.5	0.32	Comp Pro
4 1 5 2 3 Proj. Serial 4	125 125 125 125 125 125 KDSi (act) 70	40 80 50 60 MM (est) 192.2 106.8	30 20 50 10 MM(act) 218 104.6	64 25 54 Q 87 48	174.9 65.2 146.3 MM(act)*Q 18966 5021	17.8 12.2 16.6 sum MM(act)*Q 18966 23987	7569 2304	146.7 157.6 sum Q^2 7569 9873	19.4 18.5	0.32 0.38	Comp Pro
4 1 5 2 3 Proj Serial 4 1	125 125 125 126 126 125 KDSI (act) 70 40 80	40 80 50 60 MM (est) 192.2 106.8 221.1	30 20 50 10 MM(act) 218 104.6 228.4	64 25 54 Q 87 48 74	174.9 65.2 146.3 MM/(act)*Q 18966 5021 16902	17.8 12.2 16.6 sum MM(act)*Q 18966 23967 40689	75 <b>6</b> 9 2304 5476	146.7 157.6 sum Q^2 7569 9873 15349	19.4 18.5	0.32 0.38 0.35	Comp Pro
4 1 5 2 3 Proj. Serial 4	125 125 125 125 125 125 KDSi (act) 70	40 80 50 60 MM (est) 192.2 106.8	30 20 50 10 MM(act) 218 104.6	64 25 54 Q 87 48	174.9 65.2 146.3 MM(act)*Q 18966 5021	17.8 12.2 16.6 sum MM(act)*Q 18966 23987	7569 2304	146.7 157.6 sum Q^2 7569 9873	19.4 18.5	0.32 0.38	Comp Pr

		CYC	CLE #5 (Raw	Data, 125%	DSIPTK, W	Nth Underestimeti	on)				
Pro Serial	DSIPTK (%)	KOSI (act)	Under (%)	KDSI (cal)	MM (est)	TUEV (est)		MM (act)	TDEV (act)		<del></del>
5	125	80	40	48	145.2	16.6	-	256.7	20.2		
4	125	70	10	63	194.5	18.5		206.3	19.8		
2	125	50	30	35	104.9	14.6		145.6	17.5		
3	125	60	50	30	89.3	13.8		183.9	19		
1	125	40	20	32	95.5	14.1		115.8	16.6		
Pro Seriel	KDS (act)	MM (est)	MM(act)	a	Makediro	Sum MM(act)*O	0/2	sum Q/2	Coefficient	Productivity	Como Prod
5	80	250	256.7	100	25670	25670	10000	10000	!	0.31	
4	70	217.3	206.3	87	17948	43618	7569	17589	·	0.34	•—
2	50	152.6	145.6	74	10774	54392	5476	23045	,	0.34	,
3	60	184.8	183.9	74	13609	68001	5476	28521	1	0.33	,
1	40	120.7	115.8	48	5558	73559	2304	30825	2.39	0.35	0.33
		CYC	CLE #6 (Raw	Date, 125%	DSIPTK, W	Rth Underestimeti	on)				
Pro Serial	DSIPTK (%)	KDSI (act)	Under (%)	KDSI (est)	Mad (est)	TDEV (est)		MM (act)	TDEV (ect)		<u> </u>
1	125	40	40	24	67.2	12.4		109.3	17.2		
2	125	50	20	40	115	15.2		137.7	17.4		<del></del>
3	125	60	30	42	121	15.5		166.8	18.4		
4	125	70	50	35	99.9	14.4		231.3	20.4		
5	125	80	10	72	213.1	19.2		223	20.5		
Proj.Serie	KDSI (act)	MM (est)	MM(act)	a	MM(act)*Q	Sum MM(act)*Q	Q*2	sum Q*2	Coefficient	Productivity	Como Prod
7	40	115	109.3	48	5246	5246	2304	2304		0.37	
2	50	145.3	137.7	61	8400	13646	3721	6025	1	0.36	
3	60	176	168.8	74	12491	26137	5476	11501		0.36	
4	70	206.9	231.3	87	20123	46290	7569	19070		0.3	
5	80	238	223	100	22300	68560	10000	29070	2.36	0.36	0.345

### APPENDIX N. NORMALIZATION CALIBRATION STRATEGY: UNDERSIZING - 125% DSIPTK

TOLS OF THE		CY	CLE #1 (Raw	Date, 125%	DSIPTK, W	Vith Underest	imation)			<del></del>	<del> </del>	
	DSIPIK (%)	KDSI (act)	Under (%)	KDSI (est)	MM (ost)	TOEV (est)		MM (act)	TDEV (act)			
1	125	40	40	24	67.5	12.4		109.5	17.1			+
2	125	50	20	40	115.4	15.2		138.2	17.4			
3	125	60	30	42	121.5	15.5		169	18.4	l		
4	125	70	50	35	100.3	14.4		230.9	20.3			
5	125	80	10	72	214	19.2	-	224.1	20.5			
al Baral	KDSI (ad)	1400	1.000			Later - Day		Q^2	- 818			· · · · · ·
IOLSERIEL	40	MM (est)	MM(act) 109.5	100.6	48	4829	ARZO ARZO	2304	2304	Coemcient	Productivity 0.37	Comp
2	50	145.9	138.2	125	61	7625	12454	3721	6025	<del>-</del>	0.36	<del></del>
3	60	176.7	169	151.9	74	11241	23695	5476	11501	,	0.36	<del></del>
4	70	207.8	230.9	180.2	87	15677	39372	7569	19070		0.3	-
5	80	239	224.1	208.2	100	20820	60192	10000	29070	2.07	0.36	0.344
								1,000				0.000
			_ '		_	C, With Under	estimation)				<del></del>	
o Serial	DSIPTK (%)	KDSI (act)	Under (%)	KDSI (cal)	MM (est)	TDEV (est)		MM (act)	TDEV (act)		<del></del>	-
2	125	50	40	30	73.6	12.8		140.1	18.9		!	1
1	125	40	10	36	89.1	13.8		100.1	16.3			
3	125	60	20	48	120.6	15.4		164.1	19.1		<del></del>	
5	125	80	50	40	99.6	14.4		273	22.2		:	
4_	125	70	30	49	123.2	15.6		199.3	20.1			
ai Caulii T	KDSI (act)	Not fores	MM(act)	MM(norm)	- Q	Markey	sum MM(act)*Q	Q*2		Coeffee	Productivity	Care
9.500	50	175.1	140.1	125.3	81	7643	7643	3721	3721	COMMICION	0.36	Comp
4	40	138.5	100.1	98.5	48		12371	2304	6025			<u> </u>
3	60				74	4728					0.4	
	80	212.1	164.1	152.3		11270	23641	5476	11501		0.37	ļ —
5	70	286.8	273	208.6	100	20860	44501	10000	21501		0.29	
	70	249.3	199.3	180	87	15660	60161	7509	29070	2.07	0.35	0.342
mi Corial	TREATH (M.				_	K, With Under	dodinacii/					
4	125					TOEV (est)		MA (201)	TOEV (act)		<del>`</del>	
		70	20	56	141.8	TDEV (est) 16.4		MM (act) 191.9	TDEV (act) 19.1			
3	125	70 60	20 40	56 36	141.8 89.1	16.4 13.8		191.9 172.5				
1		70	20	56	141.8	16.4	•	191.9	19.1			
	125 125 125	70 60	20 40	56 36	141.8 89.1	16.4 13.8		191.9 172.5	19.1 19.7			
<u> </u>	125 125	70 60 40	20 40 50	56 36 20	141.8 89.1 48.1	16.4 13.8 10.9		191.9 172.5 109	19.1 19.7 19.1			
1 2 5	125 125 125 125	70 60 40 50 80	20 40 50 10 30	56 36 20 45 56	141.8 89.1 48.1 112.7 141.8	16.4 13.8 10.9 15.1 16.4		191.9 172.5 109 128.7 234.3	19.1 19.7 19.1 17.7 21			Carro
1 2 5	125 125 125 125 125	70 60 40 50 80	20 40 50 10 30	56 36 20 45 56 MM(norm)	141.8 89.1 48.1 112.7 141.8	16.4 13.8 10.9 15.1 16.4	sum MM(act)*Q	191.9 172.5 109 128.7 234.3	19.1 19.7 19.1 17.7 21	Coefficient	Productivity	Comp P
1 2 5 0 Serial	125 125 125 125 125 180SI (act)	70 60 40 50 80 MM (est) 179.2	20 40 50 10 30 MM(ect) 191.9	56 36 20 45 56 MM(norm) 179.9	141.8 89.1 48.1 112.7 141.8 Q	16.4 13.8 10.9 15.1 16.4 MM(act)*Q	15651	191.9 172.5 109 128.7 234.3 Q^2 7589	19.1 19.7 19.1 17.7 21 sum Q^2 7589	Coefficient	0.36	Comp P
1 2 5	125 125 125 125 125 KOSI (act) 70 60	70 60 40 50 80 MM (est) 179.2 152.4	20 40 50 10 30 MM(act) 191.9 172.5	56 36 20 45 56 MM(norm) 179.9	141.8 89.1 48.1 112.7 141.8 Q 87 74	16.4 13.8 10.9 15.1 16.4 MM(act)*Q 15851 11278	15651 28929	191.9 172.5 109 128.7 234.3 Q^2 7589 5476	19.1 19.7 19.1 17.7 21 sum Q^2 7589 13045	Coefficient	0.36 0.35	Comp P
1 2 5 0 Serial 4 3	125 125 125 125 125 KOSI (set) 70 60 40	70 60 40 50 80 MM (est) 179.2 152.4 99.6	20 40 50 10 30 MM(act) 191.9 172.5 109	56 36 20 45 56 MM(norm) 179.9 152.4 99.6	141.8 89.1 48.1 112.7 141.8 Q 87 74 74	16.4 13.8 10.9 15.1 16.4 MM(act) O 15651 11278 7370	15651 26929 34299	191.9 172.5 109 128.7 234.3 Q^2 7589 5476 5476	19.1 19.7 19.1 17.7 21 sum Q^2 7589 13045 18521	Coefficient	0.36 0.35 0.37	Comp P
1 2 5 0 Serial 4 3	125 125 125 125 125 KOSI (act) 70 60	70 60 40 50 80 MM (est) 179.2 152.4	20 40 50 10 30 MM(act) 191.9 172.5	56 36 20 45 56 MM(norm) 179.9	141.8 89.1 48.1 112.7 141.8 Q 87 74	16.4 13.8 10.9 15.1 16.4 MM(act)*Q 15851 11278	15651 28929	191.9 172.5 109 128.7 234.3 Q^2 7589 5476	19.1 19.7 19.1 17.7 21 sum Q^2 7589 13045	Coefficient	0.36 0.35	
1 2 5 0 Serial 4 3 1	125 125 125 125 126 KOSI (act) 70 60 40 50	70 60 40 50 80 MM (est) 179.2 152.4 99.6 125.9	20 40 50 10 30 MM(act) 191.9 172.5 109 128.7	56 36 20 45 56 MM(norm) 179.9 152.4 99.6 124.9	141.8 89.1 48.1 112.7 141.8 Q 87 74 74 61	16.4 13.8 10.9 15.1 16.4 MM(act) O 15851 11278 7370 7619	15651 28929 34299 41918	191.9 172.5 109 128.7 234.3 Q^2 7589 5476 5476 3721	19.1 19.7 19.1 17.7 21 sum Q*2 7589 13045 18521 22242		0.36 0.35 0.37 0.39	
1 2 5 70 Serial 4 3 1	125 125 125 125 126 KOSI (act) 70 60 40 50	70 60 40 50 80 MM (est) 179.2 152.4 99.6 125.9 206.2	20 40 50 10 30 MM(sct) 191.9 172.5 109 128.7 234.2	56 36 20 45 56 864(norm) 179.9 152.4 99.6 124.9 208.1	141.8 89.1 48.1 112.7 141.8 Q 87 74 74 61 100	16.4 13.8 10.9 15.1 16.4 MM(act)*Q 15851 11278 7370 7619 20610	15651 28929 34299 41918 62728	191.9 172.5 109 128.7 234.3 Q^2 7589 5476 5476 3721	19.1 19.7 19.1 17.7 21 sum Q*2 7589 13045 18521 22242		0.36 0.35 0.37 0.39	
1 2 5 5 70 Serial 4 3 1 2 5	125 125 125 125 125 125 10051 (ect) 70 60 40 50 80	70 60 40 50 80 MM (est) 179.2 152.4 99.6 125.9 206.2	20 40 50 10 30 MM(act) 191.9 172.5 109 128.7 234.2	56 36 20 45 56 MM(norm) 179.9 152.4 99.6 124.9 208.1	141.8 89.1 48.1 112.7 141.8 Q 87 74 74 61 100	16.4 13.8 10.9 15.1 16.4 MM(sct)*Q 15851 11278 7370 7619 20610	15651 28929 34299 41918 62728	191.9 1772.5 109 128.7 234.3 Q^2 7589 5476 5476 3721 10000	19.1 19.7 19.1 17.7 21 sum Q*2 7589 13045 18521 22242 32242		0.36 0.35 0.37 0.39	
1 2 5 5 70 Serial 4 3 1 2 5	125 125 125 125 126 126 126 126 126 127 128 128 128 128 128 128 128 128 128 128	70 60 40 50 80 MM (est) 179.2 152.4 99.6 206.2 CYCLE	20 40 50 10 30 MM(act) 191.9 172.5 109 128.7 234.2	56 36 20 45 56 MM(norm) 179.9 152.4 99.6 124.9 208.1	141.8 89.1 48.1 112.7 141.8 Q 87 74 61 100	16.4 13.8 10.9 15.1 16.4 MM(act) Q 15651 11278 7370 7619 20610	15651 28929 34299 41918 62728	191.9 172.5 109 128.7 234.3 0*2 7589 5476 5476 5476 3721 10000	19.1 19.7 19.1 17.7 21 sum Q=2 7589 13045 18521 22242 32242		0.36 0.35 0.37 0.39	
1 2 5 5 70 Serial 4 3 1 2 5	125 125 125 125 126 KOSI (act) 70 60 40 50 80	70 60 40 50 80 MM (est) 179.2 152.4 99.6 125.9 206.2 KDSJ (act)	20 40 50 10 30 MM(act) 191.9 172.5 109 128.7 234.2	56 36 20 45 56 MM(norm) 179.9 152.4 99.6 124.9 208.1 Ized Data, 1: IRDSI (est)	141.8 99.1 48.1 112.7 141.8 Q 87 74 74 74 61 100 25% DSIPTI MM (est) 98.7	16.4 13.8 10.9 15.1 16.4 MM(act)*Q 15851 11278 7370 7619 20810	15651 28929 34299 41918 62728	191.9 172.5 109 128.7 234.3 O^2 7589 5476 5476 3721 10000	19.1 19.7 19.1 17.7 21 sum Q*2 7599 13045 18521 22242 32242		0.36 0.35 0.37 0.39	
1 2 5 5 0 Serial 3 1 2 5	125 125 125 125 125 125 KOSI (set) 70 60 40 50 80 80	70 60 40 50 80 MM (est) 179.2 152.4 99.6 125.9 206.2 CYCLE KDSI (act) 70	20 40 50 10 30 MM(act) 1919 172.5 109 128.7 234.2 44 (Normal	56 36 20 45 56 MM(norm) 179.9 152.4 99.6 124.9 208.1	141.8 89.1 48.1 112.7 141.8 Q 87 74 74 76 100 100 100 100 100 100 100 100 100 10	16.4 13.8 10.9 15.1 16.4 MMM(act) 0 1585 1 11278 7370 7619 20610 C With Under	15651 28929 34299 41918 62728	191.9 172.5 109 128.7 234.3 0*2 7569 5476 5476 3721 10000	19.1 19.7 19.1 17.7 21 sum Q*2 7589 13045 18521 22242 32242		0.36 0.35 0.37 0.39	0.359
1 2 5 5 70 Serial 4 3 1 2 5 5 70 Serial 4 4 1 1	125 125 126 126 126 126 126 140 50 80 125 125 125	70 60 40 50 80 MM (est) 179.2 152.4 99.6 125.9 206.2 KDSJ (act)	20 40 50 10 30 MM(act) 191.9 172.5 109 128.7 234.2	56 36 20 45 56 MM(norm) 179.9 152.4 99.6 124.9 208.1 Ezad Dota, 1: KDSI (est) 42 28 64	141.8 69.1 48.1 112.7 141.8 Q 87 74 74 61 100 25% DSIPTI 58.7 64.5 59.7 64.5 153.6	16.4 13.8 10.9 15.1 16.4 MM(act)*Q 15851 11278 7370 7619 20610 C With Under	15651 28929 34299 41918 62728	191.9 172.5 109 128.7 234.3 0*2 7589 5476 5476 5476 3721 10000	19.1 19.7 19.1 17.7 21 sum Cr2 7589 13045 18821 22242 32242 10EV (act) 20.8 17.6 21.2		0.36 0.35 0.37 0.39	
1 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	125 125 125 125 125 125 KOSI (set) 70 60 40 50 80 80	70 60 40 50 80 MM (est) 179.2 152.4 99.6 125.9 206.2 CYCLE (KDSI (act) 70 40 80	20 40 50 10 30 MM(act) 191.9 172.5 109 128.7 234.2 ** (Normal	56 36 20 45 56 MM(norm) 179.9 152.4 99.6 124.9 208.1 Izad Data, 1: RDSI (est) 42 28	141.8 89.1 48.1 112.7 141.8 Q 87 74 74 76 100 100 100 100 100 100 100 100 100 10	16.4 13.8 10.9 15.1 16.4 MMM(act) 0 1585 1 11278 7370 7619 20610 C With Under	15651 28929 34299 41918 62728	191.9 172.5 109 128.7 234.3 0*2 7569 5476 5476 3721 10000	19.1 19.7 19.1 17.7 21 sum Q*2 7589 13045 18521 22242 32242		0.36 0.35 0.37 0.39	
1 2 5 5 Serial 4 3 1 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	125 125 126 126 126 126 126 127 10 60 40 50 60  DSIPTK (%) 125 125 125 125 125	70 60 40 50 80 MM (est) 179.2 152.4 99.6 125.9 206.2 CYCLE (KDS) (act) 70 40 80 50 60	20 40 50 10 30 MM(act) 191.9 109 128.7 234.2 ** (Normal Under (%) 40 30 20 50	56 36 20 45 56 MM(norm) 179.9 152.4 99.6 124.9 208.1 Ezad Data, 1: KDSI (est) 42 28 64 25 54	141.8 69.1 48.1 112.7 141.8 Q 87 74 74 61 100 25% DSIPTI 1887 (est) 59.7 64.5 153.6 57.3 128.5	16.4 13.8 10.9 15.1 16.4 MM(act)**Q 15651 11278 7370 7619 20610 **C With Under	15851 28929 34299 41918 62728	191.9 172.5 109 128.7 234.3 C*2 7589 5476 5476 3721 10000	19.1 19.7 19.1 17.7 21 sum O*2 7589 13045 18521 22242 32242 32242 TDEV (act) 20.8 17.6 20.1 18.9	1.95	0.36 0.35 0.37 0.39 0.34	0.359
1 2 5 5 9 1 2 5 9 1 2	125 125 125 126 126 126 127 127 128 128 128 128 128 128 128 128 128 128	70 60 40 50 80 MM (est) 179.2 152.4 99.6 125.9 206.2 CYCLE (KDSI (act) 70 40 80 50 60	20 40 50 10 30 191.9 172.5 109 128.7 234.2 44 (Normal Under (%) 40 30 50 10	56 36 20 45 56 MM(norm) 179.9 152.4 99.6 124.9 208.1 IZED Data, 1: IZED	141.8 99.1 48.1 112.7 141.8 Q 87 74 74 61 100 100 100 100 100 100 100	16.4 13.8 10.9 15.1 16.4  MM(act)*Q 15851 112278 7370 7619 20810  TDEV (est) 14.3 12.2 16.9 11.6 15.8	15851 28929 34299 41918 62728 restimation)	191.9 172.5 109 128.7 234.3 O^2 7589 5476 5476 3721 10000 MM (act) 205.8 105.2 219.4 138.7 154.8	19.1 19.7 19.1 17.7 21 sum Q*2 7589 13045 18521 22242 32242 32242 17.6 20.8 17.6 21.2 20.1 18.9	1.95	0.36 0.35 0.37 0.39 0.34	0.359
1 2 5 5 9 1 2 5 9 1 2	125 125 125 125 125 125 125 126 127 127 127 128 128 128 128 128 128 128 128 128	70 60 40 40 50 80 MM (est) 1792 1524 99.6 99.6 206.2 CYCLE 70 40 80 50 60	20 40 50 10 30 MM(act) 1919 172.5 109 128.7 234.2 44 (Normal 40 30 20 50 10	56 36 20 45 56 MM(norm) 179.2 99.6 124.9 208.1 IRDSI (est) 42 28 64 25 54	141.8 89.1 48.1 112.7 141.8 Q 87 74 74 74 61 100 25% DSIPTI MM (est) 98.7 64.5 153.6 57.3 128.5	16.4 13.8 10.9 15.1 16.4 MM/(act)*Q 15851 11278 7370 7619 20810 TDEV (est) 14.3 12.2 16.9 17.6 15.9 17.6 15.8	15851 28929 34299 41918 62728 restimation)	191.9 172.5 109 128.7 234.3 0°2 7589 5476 5476 5476 3721 100000 10000 10000 10000 100000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 1	19.1 19.7 19.1 17.7 21 sum G*2 7589 13045 18521 22242 32242 TDEV (act) 20.8 21.2 20.1 18.5 21.2 20.1 18.5 21.2 20.1 18.5 21.2 20.1 20.5 20.1 20.5 20.1 20.5 20.1 20.5 20.1 20.5 20.1 20.1 20.5 20.1 20.1 20.1 20.1 20.1 20.1 20.1 20.1	1.95	0.36 0.35 0.37 0.39 0.34	0.359
1 2 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5	125 125 126 126 126 127 127 128 128 129 129 120 125 125 125 125 125 125 125 125 126 127 127 128	70 60 40 50 80 MM (est) 179.2 152.4 99.6 125.9 206.2 CYCLE (KDSI (act) 70 40 80 50 60 MM (est)	20 40 50 10 30 191.9 172.5 109 128.7 234.2 24 (Normal 40 30 20 50 10 10 10 10 10 10 10 10 10 10 10 10 10	56 36 20 45 56 MM (norm) 179.9 152.4 99.6 124.9 208.1 KDSI (est) 42 28 64 25 54 MM (norm) 180.2	141.8 69.1 48.1 112.7 141.8 Q 87 74 74 61 100 25% DSIPTI 1801 (est) 99.7 64.5 153.6 57.3 128.5 Q 87 48	16.4 13.8 10.9 15.1 16.4  MM(act)*Q 15851 11278 7370 7619 20610  C With Under 118.9 11.6 15.8  MM(act)*Q 15.8	15851 28929 34299 41918 62728 restimation)	191.9 172.5 109 128.7 234.3 C*2 7589 5476 5476 3721 10000 WM (act) 205.8 105.2 219.4 138.7 154.8 C*2 7589 2304	19.1 19.7 19.1 17.7 21 sum O*2 7589 13045 18521 22242 32242 32242 170EV (act) 20.8 17.6 20.1 18.9 18.9 18.9 18.9 18.9 18.9 18.9	1.95	0.36 0.35 0.37 0.39 0.34	0.359
1 2 5 5 9 1 2 5 9 1 2 5	125 125 125 125 125 125 125 126 127 127 127 128 128 128 128 128 128 128 128 128	70 60 40 40 50 80 MM (est) 1792 1524 99.6 99.6 206.2 CYCLE 70 40 80 50 60	20 40 50 10 30 MM(act) 1919 172.5 109 128.7 234.2 44 (Normal 40 30 20 50 10	56 36 20 45 56 MM(norm) 179.2 99.6 124.9 208.1 IRDSI (est) 42 28 64 25 54	141.8 89.1 48.1 112.7 141.8 Q 87 74 74 74 61 100 25% DSIPTI MM (est) 98.7 64.5 153.6 57.3 128.5	16.4 13.8 10.9 15.1 16.4 MM/(act)*Q 15851 11278 7370 7619 20810 TDEV (est) 14.3 12.2 16.9 17.6 15.9 17.6 15.8	15851 28929 34299 41918 62728 restimation)	191.9 172.5 109 128.7 234.3 0°2 7589 5476 5476 5476 3721 100000 10000 10000 10000 100000 10000 10000 10000 10000 10000 10000 10000 10000 10000 10000 1	19.1 19.7 19.1 17.7 21 sum G*2 7589 13045 18521 22242 32242 TDEV (act) 20.8 21.2 20.1 18.5 21.2 20.1 18.5 21.2 20.1 18.5 21.2 20.1 20.5 20.1 20.5 20.1 20.5 20.1 20.5 20.1 20.5 20.1 20.1 20.5 20.1 20.1 20.1 20.1 20.1 20.1 20.1 20.1	1.95	0.36 0.35 0.37 0.39 0.34	0.359

		CYCLE	#5 (Normal	ized Data, 13	25% OSIPTI	C, With Under	restimation)			<del> </del>		
Pro Seriel	DSPTK (%)	KDSI (act)	Under (%)	KOSI (est)	MM (est)	TDEV (est)		MM (act)	TDEV (act)			
5	125	80_	40	48	129.9	15.9		257.3	21			
4	125	70	10	63	172.8	17.7		186.7	19.6		• • • • • • • • • • • • • • • • • • • •	,
2	125	50_	30	35	93.2	14		134.B	17.8			
3	125	60	50	30	79.3	13.2		184.5	20.1			
_1	125	40	20	32	84.9	13.5		102.8	16.3			
10.Sen	KDSI (act)	MM (est)	MM(act)	Mad(norm)	a	MM(act)*Q	sum Millacil O	Q^2	sum Q-2	Conficient	Productivity	Comp Pro
5	<b>30</b>	222.1	257.3	208.2	100	20820	20820	10000	10000		0.31	
4	70	193	186.7	179.7	87	15634	36454	7569	17569		0.37	,
2	50	135.6	134.8	125.2	74	9265	45719	5476	23045	•	0.37	
3	60	164.2	184.5	152.6	74	11292	57011	5476	28521		0.33	
1	40	107.3	102.8	98.5	48	4728	61739	2304	30825	2	0.39	0.346
		CYCLE	#6 (Norma	ized Data, 12	25% DSIPTI	C, With Unde	restimation)				·	
200	DSPTK(%)	(OSI/OFI)	Under (%)	(08)(64)	W (est)	TOEV (CON	<del>,                                    </del>	MM (act)	TDEV (act)			
1	125	40	40	24	56.3	11.6		105.8	18.3			
2	125	50	20	40	96.2	14.2		133.6	18.2			
3	125	60	30	42	101.3	14.5		165.6	19.4			
4	125	70	50	35	83.6	13.4		217.7	21.4		1	
5	125	80	10	72	178.3	17.9	-	212.2	21.3			
and Serial	KDSI (act)	AAA (Ant)	Marth	MM(nom)	٥	Marines Co	sum MM(acl)*O	0/2	9HM (242	Control	Productivity	Como Pro
1	40	96.2	106.8	***************************************	48		· mangacay or	2304	2304		0.37	Cong File
	50	121.6	133.6		61	<del></del> -	<del></del>	3721	6025	<del></del>	0.37	
3	80	147.3	165.6		74	<del></del>	·	5476	11501		0.36	,
	70	173.1	217.7		87			7569	19070	i	0.32	
4	. 70											

# APPENDIX O. NORMALIZATION DATA: UNDERSIZING - 125% DSIPTK

C	YCLE #1, F	PROJECT	#1	— с	YCLE #1, I	PROJECT	#2
KDSI (est)	TDEV (est)		MM (act)	KDSI (est)	TDEV (est)	MM (est)	MM (act)
40	17.1	109.5	109.4	50	17.4	138.2	137.8
40	17.1	105	104.6	50	17.4	130	129.6
40	17.1	103	102.6	50	17.4	120	128.4
40	17.1	100	101	50	17.4	115	127.2
40	17.1	98	100.6	50	17.4	110	125.9
40	17.1	95	101.3	50	17.4	105	125
L				50	17.4	100	125
L	·			50	17.4	98	125.2
	<b></b>			50	17.4	95	125.8
	YCLE #1, I		#3		YCLE #1, I		#4
	TDEV (est)		MM (act)		TDEV (est)		MM (act)
60	18 4	169	168.5	70	20.3	230.9	225
60	1 <b>4</b>	150	155.8	70	20.3	200	199.4
60	18.4	130	152.3	70	20.3	180	185.8
60	18.4	128	152.4	70	20.3	175	184.3
60	18.4	125	151.9	70	20.3	170	182.7
60	18.4	123	152	70	20.3	165	181.4
60	18.4	120	152.6	70	20.3	160	180.3
60	18.4	115	153.6	70	20.3	150	189.2
L				70	20.3	145	180.7
	YCLE #1, I				YCLE #2, I		
80	TDEV (est) 20.5	MM (est) 224.1	MM (act) 223.5	50 KUSI (est)	TDEV (est) 18.9	MM (est) 140.1	MM (act) 139.9
80	20.5	190	209.4	50	18.9	130	129.8
80	20.5			50			
80		120	201213 1		י אור י	720	. 128 <i>4</i> .
		180 178	208.3		18.9 18.9	120 115	128.4 126.5
1 80	20.5	178	296.2	50	18.9	115	126.5
80 80	20.5 20.5	178 175	298.2 208.3	50 50	18.9 18.9	115 110	126.5 125.7
80 80 80	20.5	178	296.2	50	18.9	115	126.5
80	20.5 20.5 20.5	178 175 170	298.2 208.3 209	50 50 50	18.9 18.9 18.9	115 110 105	126.5 125.7 125.3
80 80	20.5 20.5 20.5 20.5	178 175 170 165	298.2 208.3 209 209.7	50 50 50 50	18.9 18.9 18.9 18.9	115 110 105 100	126.5 125.7 125.3 125.6
80 80 80	20.5 20.5 20.5 20.5	178 175 170 165 150	298.2 208.3 209 209.7 214	50 50 50 50 50 50	18.9 18.9 18.9 18.9	115 110 105 100 95	126.5 125.7 125.3 125.6 127.1
80 80 80	20.5 20.5 20.5 20.5 20.5 20.5	178 175 170 165 150 PROJECT	298.2 208.3 209 209.7 214	50 50 50 50 50	18.9 18.9 18.9 18.9 18.9	115 110 105 100 95 PROJECT	126.5 125.7 125.3 125.6 127.1
80 80 80	20.5 20.5 20.5 20.5 20.5 20.5 YCLE #2, U	178 175 170 165 150 PROJECT	298.2 208.3 209 209.7 214 #1 MM (act) 100.9	50 50 50 50 50	18.9 18.9 18.9 18.9 18.9 YCLE #2, I	115 110 105 100 95 PROJECT MM (est) 164.1	126.5 125.7 125.3 125.6 127.1
80 80 80 C KDSI (est) 40	20.5 20.5 20.5 20.5 20.5 20.5 20.5 YCLE #2, ITDEV (est) 16.3	178 175 170 165 150 PROJECT MM (est) 100.1	298.2 208.3 209 209.7 214 #1 MM (act) 100.9 100.3	50 50 50 50 50 50 C KD\$I (est) 60 60	18.9 18.9 18.9 18.9 18.9 YCLE #2, I TDEV (est) 19.1	115 110 105 100 95 PROJECT MM (est) 164.1 140	#3 MM (act) 153.8
80 80 80 CC KDSI (est) 40 40	20.5 20.5 20.5 20.5 20.5 20.5 YCLE #2, TDEV (est) 16.3 16.3	178 175 170 165 150 PROJECT MM (est) 100.1 90 80	#1 MM (act) 100.9 100.3 98.7	50 50 50 50 50 50 C KD\$I (est) 60 60	18.9 18.9 18.9 18.9 18.9 YCLE #2, I TDEV (est) 19.1 19.1	115 110 105 100 95 PROJECT MM (est) 164.1 140 130	#3 MM (act) 153.8 152.4
80 80 80 CC KDSI (est) 40 40 40	20.5 20.5 20.5 20.5 20.5 20.5 20.5 YCLE #2, ITDEV (est) 16.3 16.3 16.3	178 175 170 165 150 PROJECT MM (est) 100.1 90 80 75	298.2 208.3 209 209.7 214 #1 MM (act) 100.9 100.3 98.7 98.5	50 50 50 50 50 50 50 C KDSI (est) 60 60 60	18.9 18.9 18.9 18.9 18.9 YCLE #2, I TDEV (est) 19.1 19.1 19.1	115 110 105 100 95 PROJECT MM (est) 164.1 140 130 125	#3 MM (act) 153.8 152.4 152.3
80 80 80 CC KDSI (est) 40 40	20.5 20.5 20.5 20.5 20.5 20.5 YCLE #2, TDEV (est) 16.3 16.3	178 175 170 165 150 PROJECT MM (est) 100.1 90 80	#1 MM (act) 100.9 100.3 98.7	50 50 50 50 50 50 50 C KDSI (est) 60 60 60 60	18.9 18.9 18.9 18.9 18.9 YCLE #2, I TDEV (est) 19.1 19.1 19.1	115 110 105 100 95 PROJECT MM (est) 164.1 140 130 125 120	#3 MM (act) 153.8 152.4 153.2
80 80 80 CC KDSI (est) 40 40 40	20.5 20.5 20.5 20.5 20.5 20.5 20.5 YCLE #2, ITDEV (est) 16.3 16.3 16.3	178 175 170 165 150 PROJECT MM (est) 100.1 90 80 75	298.2 208.3 209 209.7 214 #1 MM (act) 100.9 100.3 98.7 98.5	50 50 50 50 50 50 50 C KDSI (est) 60 60 60	18.9 18.9 18.9 18.9 18.9 YCLE #2, I TDEV (est) 19.1 19.1 19.1	115 110 105 100 95 PROJECT MM (est) 164.1 140 130 125	#3 MM (act) 153.8 152.4 152.3
80 80 80 CC KDSI (est) 40 40 40	20.5 20.5 20.5 20.5 20.5 20.5 20.5 YCLE #2, ITDEV (est) 16.3 16.3 16.3	178 175 170 165 150 PROJECT MM (est) 100.1 90 80 75	298.2 208.3 209 209.7 214 #1 MM (act) 100.9 100.3 98.7 98.5	50 50 50 50 50 50 50 C KDSI (est) 60 60 60 60	18.9 18.9 18.9 18.9 18.9 YCLE #2, I TDEV (est) 19.1 19.1 19.1	115 110 105 100 95 PROJECT MM (est) 164.1 140 130 125 120	#3 MM (act) 153.8 152.4 153.2
80 80 80 CC KDSI (est) 40 40 40	20.5 20.5 20.5 20.5 20.5 20.5 20.5 YCLE #2, ITDEV (est) 16.3 16.3 16.3	178 175 170 165 150 PROJECT MM (est) 100.1 90 80 75	298.2 208.3 209 209.7 214 #1 MM (act) 100.9 100.3 98.7 98.5	50 50 50 50 50 50 50 C KDSI (est) 60 60 60 60	18.9 18.9 18.9 18.9 18.9 YCLE #2, I TDEV (est) 19.1 19.1 19.1	115 110 105 100 95 PROJECT MM (est) 164.1 140 130 125 120	#3 MM (act) 153.8 152.4 153.2

C,	YCLE #2, F	PROJECT	#5	С	YCLE #2, F	PROJECT	#4
KDSI (est)	TDEV (est)	MM (est)	MM (act)	KDSI (est)	TDEV (est)	MM (est)	MM (act)
80	22.2	273	262.4	70	20.1	199.3	198.6
80	22.2	250	248.1	70	20.1	170	182.8
80	22.2	230	229.2	70	20.1	160	180.5
80	22.2	210	215.8	70	20.1	155	180
80	22.2	190	209.2	70	20.1	150	180
80	22.2	180	208.6	70	20.1	145	180.5
80	22.2	170	210.4	70	20.1	130	185.3
					· · · · · · · · · · · · · · · · · · ·		
C,	YCLE #3, F	PROJECT		<u>C</u>	YCLE #3, F	PROJECT	#3
	TDEV (est)		MM (act)		TDEV (est)		MM (act)
70	19.1	191.9	191.3	60	19.7	172.5	172.2
70	19.1	180	184.6	60	19.7	160	159.7
70	19.1	170	182.9		19.7	150	157.2
70	19.1	160	180.4	60	19.7	140	153.8
70	19.1	155	180.2	60	19.7	130	152.6
70	19.1	150	179.9	60	19.7	125	152.4
70	19.1	145	180.2	60	19.7	120	153.6
70 70	19.1	140	181		<del></del>		<del> </del>
70	19.1	130	185.5				
C	YCLE #3, I	PROJECT	#1	C.	YCLE #3, F	PROJECT	#2
	TDEV (est)		MM (act)		TDEV (est)		MM (act)
40	19.1	109	108.6	50	17.7	128.7	129.1
40	19.1	100	101.7	50	17.7	120	128.9
40	19.1	90	100	50	17.7	110	126
40	19.1	85	99.6	50	17.7	105	125.1
40	19.1	80	99.8	50	17.7	100	124.9
40	19.1	75	101.1	50	17.7	95	126.1
40	19.1	70	103.3	50	17.7	90	128.2
C	YCLE #3, F	PROJECT	#5	С	YCLE #4, F	PROJECT	#4
	TDEV (est)		MM (act)		TDEV (est)		MM (act)
80	21	234.3	233.9	70	20.8	205.8	205
80	21	220	219.2	70	20.8	190	189.2
80	21	200	212.1	70	20.8	170	182.5
	21	180	208.2	70	20.8	165	181.1
80		4=0	208.1	70	20.8	160	180.3
80 80	21	178					
80 80 80	21	175	208.2	70	20.8	155	180.2
80 80 80 80	21 21	175 170	208.2 209.3	70 70	20.8 20.8	155 150	180.6
80 80 80	21	175	208.2	70	20.8	155	

C	CYCLE #4, F	PROJECT	#1	 CYCLE #4, PROJECT #5				
KDSI (est)	TDEV (est)	MM (est)	MM (act)	 KDSI (est)	TDEV (est)	MM (est)	MM (act)	
40	17.6	105.2	105	80	21.2	219.4	218.7	
40	17.6	100	101.2	80	21.2	200	212	
40	17.6	90	100.2	80	21.2	190	209.4	
40	17.6	85	99.2	80	21.2	185	208.7	
40	17.6	83	99	 80	21.2	180	208	
40	17.6	80	99.2	80	21.2	175	208.5	
40	17.6	75	100.1	 80	21.2	170	209	
40	17.6	70	102.1	80	21.2	160	213.1	

CYCLE #4, PROJECT #2			#2	c	CYCLE #4, PROJECT #3		
KDSI (est)	TDEV (est)	MM (est)	MM (act)	KDSI (est)	TDEV (est)	MM (est)	MM (act)
50	20.1	138.7	138.2	60	18.9	154.8	156.5
50	20.1	130	130.1	60	18.9	140	153.9
50	20.1	120	127.9	60	18.9	135	153.1
50	20.1	115	126.6	60	18.9	130	152.1
50	20.1	110	125.9	60	18.9	128	152.1
50	20.1	105	126	60	18.9	125	152.1
50	20.1	100	126.7	60	18.9	120	153.2
					,		

CYCLE #5, PROJECT #5			#5	CYCLE #5, PROJECT #4			#4
KDSI (est)	TDEV (est)	MM (est)	MM (act)	KDSi (est)	TDEV (est)	MM (est)	MM (act)
80	21	257.3	254.4	70	19.6	186.7	186.7
80	21	240	239.1	70	19.6	165	181.4
80	21	220	219.2	70	19.6	155	180.1
80	21	200	212.1	70	19.6	150	179.7
80	21	190	209.6	70	19.6	145	180.3
80	21	180	206.2	70	19.6	140	181.5
80	21	177.5	208.2	70	19.6	130	186.2
80	21	175	208.2				
80	21	160	213.8				

50     17.8     134.8     134.6     60     20.1       50     17.8     120     128.8     60     20.1       50     17.8     110     125.9     60     20.1       50     17.8     105     125.4     60     20.1	MM (est) MM (act 184.5 182.9
50     17.8     134.8     134.6     60     20.1       50     17.8     120     128.8     60     20.1       50     17.8     110     125.9     60     20.1       50     17.8     105     125.4     60     20.1	184 5 182 9
50     17.8     110     125.9     60     20.1       50     17.8     105     125.4     60     20.1	102.0
50 17.8 105 125.4 60 20.1	160 159.5
	140 153.6
50 470 400 4050	135 152.8
50 17.8 100 <b>125.2</b> 60 20.1	130 152.6
50 17.8 95 126.3 60 20.1	125 152.8
50 17.8 90 128.4 60 20.1	120 153.8

С	YCLE #5, F	ROJECT	#1
KDSI (est)	TDEV (est)	MM (est)	MM (act)
40	16.3	102.€	102.4
40	16.3	90	100.3
40	16.3	80	98.7
40	16.3	77.5	98.9
40	16.3	75	98.5
40	16.3	72.5	99.5
40	16.3	70	100.5
40	16.3	65	103.3

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